Unit 12 Barratt Trading Estate, Denmore Road, Bridge of Don, Aberdeen AB23 8JW

User Manual
Monoblock BOP System
7 3/8'' ID 10K

Part No 193-4653-HV0

Including:
Top Sub Assembly 125-3216-HV0
Bottom Sub Assembly 125-3215-HV0

This is a certified safety critical product and modifications or changes not authorised by Phuel Oil Tools may compromise the Safety, Functionality and Certification of the assembly.

Table of Contents

Revision History iv
Safety v
1 Introduction 1
1.1 General 1
1.2 Product Identification 2
2 Technical Specification 3
3 Technical Description 6
3.1 Basic Description 6
4 Basic Operation 8
4.1 Operating the Rams 8
4.1.1 Hydraulic Operation 8
4.1.2 Manual Operation 8
4.1.3 Locking the Rams 8
4.1.4 Proper Use 9
4.1.5 Bleed Down Rate in Gas Wells 9
4.2 Equalising across the rams 9
4.3 Job Planning 14
4.3.1 Before the Job 14
4.3.2 During the Job 14
4.3.3 After the Job 14
5 Operational Characteristics 16
5.1 Sealing Characteristics 16
5.1.1 Minimum Hydraulic Pressure 16
5.1.2 Opening the BOP with differential pressure 16
5.2 Fatigue Testing 16
5.3 Ram Access Testing 17
5.4 Shearing Performance and limitations 17
5.5 Performance of Ram Guides 17
5.6 Temperature and Pressure Limitations 18
5.6.1 General Sealing 18
5.6.2 Blind Ram Shear Seals 18
5.6.3 Wireline Multi-Seals 18
6 Maintenance 19
6.1 Introduction 19
6.2 Schedule 19
6.2.1 Pre & Post Job 19
6.2.2 Yearly 19
6.2.3 Five Yearly 19
7 Safety 20
7.1 Ram Seal Redress 20
7.1.1 Access Rams 20
7.1.2 Ram Removal (not required to redress ram seals) 21
7.1.3 Ram Seal Redress 21
7.1.4 Re-attach to BOP Body 22

7.2 Special Tools 23
7.3 Maintenance Record Sheet 27
8 Testing 28
8.1 Prepare BOP for pressure testing 28
8.2 Body Test 28
8.3 Ram test: Shear seal 29
8.4 Wireline Ram Seal Test (Between the ram) 29
8.5 Post Test Procedure 30
9 Parts List and Drawings 31
10 Spares 49
10.1 Supporting Equipment 50

Table 1: Technical Data 3
Table 2: Shearing performance and limitations 17
Table 3:Maintenance Record 27
Table 4: 193-4653-HV0 Parts List 31
Table 5: 7-3/8" Balanced Actuator Assembly 190-4727-HV0 34
Table 6: 10K Balanced Actuator Assembly 190-4711-HV0 36
Table 7: Equalisation Assy 190-4768-HV0 38
Table 8: Top Sub Assy Parts List 125-3216-HS0 39
Table 9: Bottom Sub Parts List 125-3215-HV0 41
Table 10: Wireline Ram Assy 190-4755-HH0 43
Table 11: Shear Ram Assy 190-4752-HH0 44
Table 14: 10K SWIVEL ASSY 190-4820-HV0 47
Table 15: BOP Full Elastomer Redress Kit RDK-4120-HV0 (No Ram Seals) 49
Table 16: Modular Body Redress Kit RDK-4859-HV0 49
Table 17: Actuator Redress Kit RDK-4952-HH0 49
Table 18: Wireline Ram Redress Kit RDK-4863-HH0 49
Table 19: Shear Ram Redress Kit RDK-4864-HH0 49
Table 20: Equalisation Redress Kit RDK-4765-HV0 50
Table 21: Triple Injection Redress Kit RDK-4866-HV0 50
Table 23: 15-2 QU Bottom Sub Redress Kit RDK-3152-HV0 50

Figure 1: BOP v
Figure 2: Typical identification tag 2
Figure 3: Dimensional Data (193-4120) 4
Figure 4: Qualified Operating Envelope, Inner Seals, (Tested Blind) 5
Figure 5: Section through BOP rams (closed position) 6
Figure 6: Equalisation Layout 10
Figure 7: Equalisation Operation 1 11
Figure 8: Equalisation Operation 2 12
Figure 9: Equalisation Operation 3 13
Figure 10: Correct lubrication for storage 15
Figure 11: Accessing the rams 20
Figure 12: BOP Wireline Rams 21
Figure 13: BOP Shear Rams 22
Figure 14: 950-4656-316 - Piston Assembly Tool 23

Figure 15: Actuator Module (Part 1) – *Item Nos refer to Parts List 190-4711-HV0* .. 24
Figure 16: Actuator Module (Part 2) – Item Nos refer to Parts List 190-4711-HV0 .. 25
Figure 17: Final Actuator – *Item Nos refer to Parts List 190-4727-HV0* 26
Figure 18: BOP (Part 1)..... 32
Figure 19: BOP (Part 2)..... 33
Figure 20: 7-3/8" Balanced Actuator 190-4727-HV0 35
Figure 21: 10K Balanced Actuator Assembly 190-4711-HV0..... 37
Figure 22: Equalisation Assy 190-4768-HV0..... 38
Figure 23: Top Sub Assy 125-3216-HV0..... 40
Figure 24: Bottom Sub Assy 125-3215-HV0 42
Figure 25: Wireline Ram Assy 190-4755-HH0 43
Figure 26: Shear Ram Assy 190-4752-HH0..... 44
Figure 27: Triple Injection Module 193-4812-HV0..... 46
Figure 28: Right Angled Swivel Assy 190-4820-HV0 47

Revision History

Issue, Release Date	Description
Rev A, 31 Oct 12	Initial Issue
Rev B, 8 Apr 15	Changed Shear Blade Part No

Safety

WARNING: When trapped is compressed it is highly dangerous. It has enough stored energy to separate parts with considerable force.

This product contains high pressures, when in operation. Failure of any part may cause injury. Welding, corrosion, rough handling, or other abuse may affect the Integrity of this product.

All pressure equipment has a particular pressure rating and care must be taken to ensure that no item is used in a situation that may cause its working pressure to be exceeded.

All personnel involved in pressure testing must be formally trained, competent and utilise the appropriate PPE.

Ensure the identification plate is fitted and is displaying the correct information

This equipment and the equipment it is attached to is heavy never position yourself below a suspended load

The Actuator piston has two seals with vent holes to prevent communication of well pressure to the hydraulic chambers (on opposite side of grease nipple). These vent holes must never be blanked off.

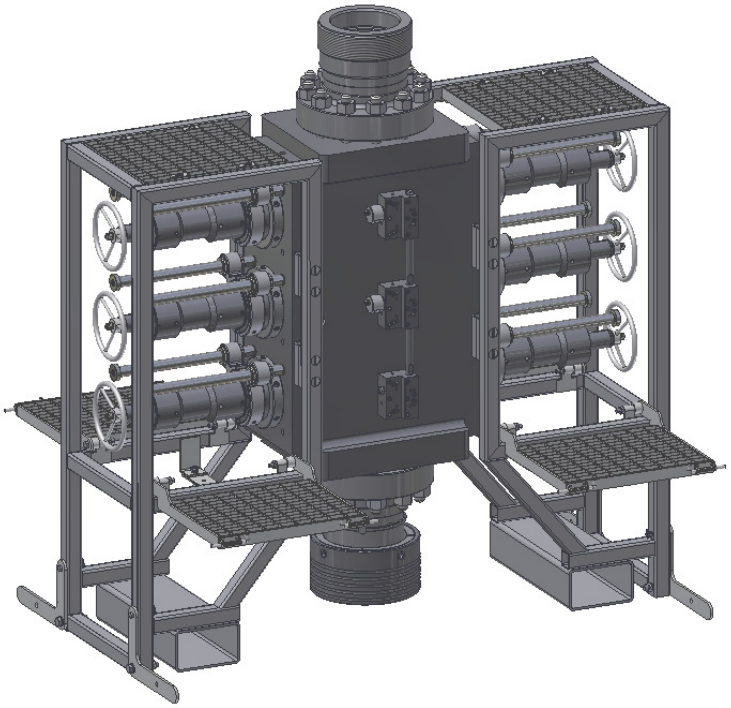


Figure 1: BOP

1 Introduction

1.1 General

The Blow Out Preventer (BOP) provides essential safety barriers against well pressure during wireline operations. It is usually located directly above the hristmas tree flange. The BOP (Depending on configuration) can have one or more sets of wireline rams for sealing against well pressure on slick line and/or braided line. Shear and seal rams are also available these are capable of cutting through the wire and then sealing against the well pressure.

The ram consists of a hydraulic piston that can be extended or retracted to energise or retract the ram. The ram has a set of inner and horse shoe outer seals that when compressed against the opposite ram forms a continuous seal that is further energised by the application of pressure in one direction. The ram consequently can be arranged so that it holds pressure from below the BOP or from above.

Across the rams there is an equalisation valve assembly. This is used to equalise pressure across the rams so that the rams can be withdrawn to open up the well bore. The equalisation valve assembly consists of a cone seal set on a screw. Unwinding the screw opens the valve and allows equalisation across the rams. Tightening the screw closes the seal and prevents pressure from passing through the valve assembly. There is a circuit to allow the injection of chemicals into the well or across the equalisation valves, and can be used to prevent the valves freezing while bleeding down gas (by injecting glycol for example). The injection port has a check valve to prevent well pressure entering the injection system.

Between inverted rams, it is possible to inject grease through the injection port located at the rear of the BOP. For braided line operations or in cases where an effective seal cannot be achieved, the injection port can be used to inject grease at pressures greater than the well head pressure, limited to the maximum working pressure of the BOP. The injection port has a check valve to prevent well pressure entering the injection system.

The BOP is mounted to a crash frame assembly that provides forklift pockets protection during transport. The crash frame has foldable platforms for the operators to stand on when operating the BOP and stabbing in the lubricator.

This user manual serves as an introduction to the equipment and contains the relevant specifications, operation, planning and maintenance instructions, parts list and drawings.

1.2 Product Identification

Phuel products are identified by a unique serial number that facilitates full product traceability. Each product is supplied with a documentation pack that contains product certification and material/inspection reports. The serial number is always etched on the surface of the product but can sometimes be difficult to find or read after painting. A customer identification number is also included to allow the customer to track the asset in their system.

A stainless steel band secures the nameplate tag that is stamped with the information shown below. This tag should be located in the first instance to ensure that this manual refers to the correct equipment.

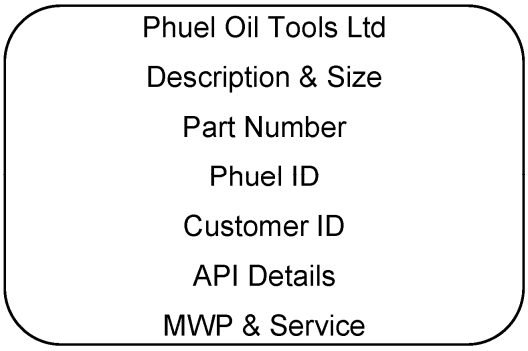


Figure 2: Typical identification tag

2 Technical Specification

Part Number	193-4653-HV0
Top Connection	13-4 ACME Quick Union Box X 7-1/16” 10M API Flange (BX156)
Bottom Connection	13-4 ACME Quick Union Pin/ Collar X 7-1/16” 10M API Flange (BX156)
Height (Make Up)	78.55”/ 1.995 m
Height (Overall)	85.42”/ 2.170 m
Width	81.17”/ 2.062 m
Depth	24.73”/ 0.628 m
Working Pressure	10,000 PSI (689 Bar)
Test Pressure	15,000 PSI (1034 Bar)
Temperature (Metal)	-30 to 121 DegC
Temperature (Seals)	0 to 121 DegC
Temperature (Inner / Outer Seals)	See Figure 4
Service	H_2S
Wire size	Up to 15/32”
Hydraulic Pressure	3,000 psi (200 Bar) Max (Standard Actuators)
Stroke Volume	49.93 cu-in / 0.82L to close – 37.47 cu-in / 1.15L to open per Actuator
Weight	7948 lbs. (3605 Kg)
Hydraulic Connections	Wireline Rams – QR74 Quick Release Coupling (Female to close)
	Shear Rams – QR74 Quick Release Coupling (Female to close)
	Grease Injection – Female QR74 Quick Release Coupling
	Chemical Injection Port – Male Snap-Tite 71
	Gauge Port – 1/2” NPT (10,000 psi max WP)
Torque For Fasteners	Refer to DOC-3821
Manual Back-up	30 to 40 turns

Table 1: Technical Data

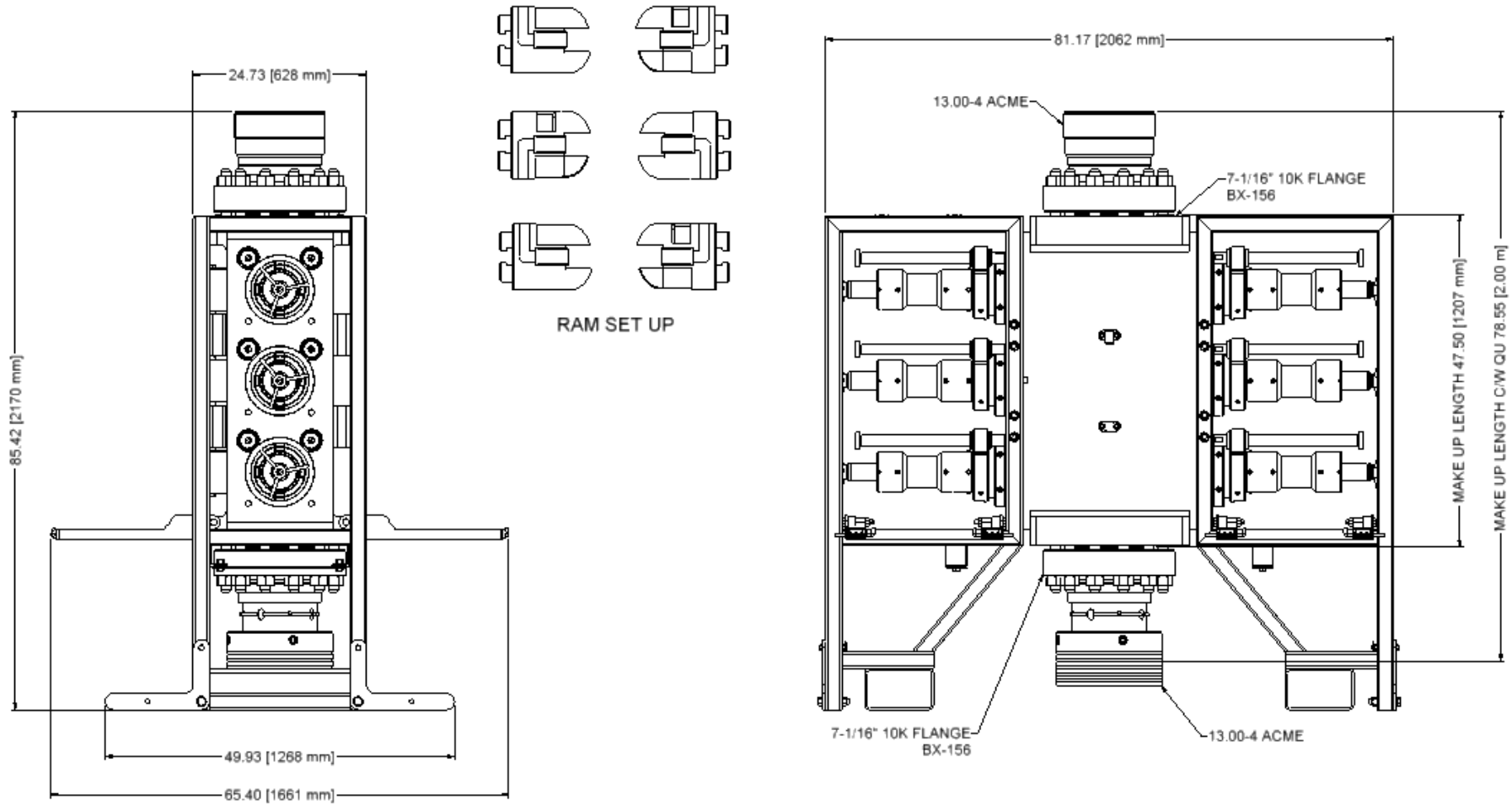


Figure 3: Dimensional Data (193-4120)

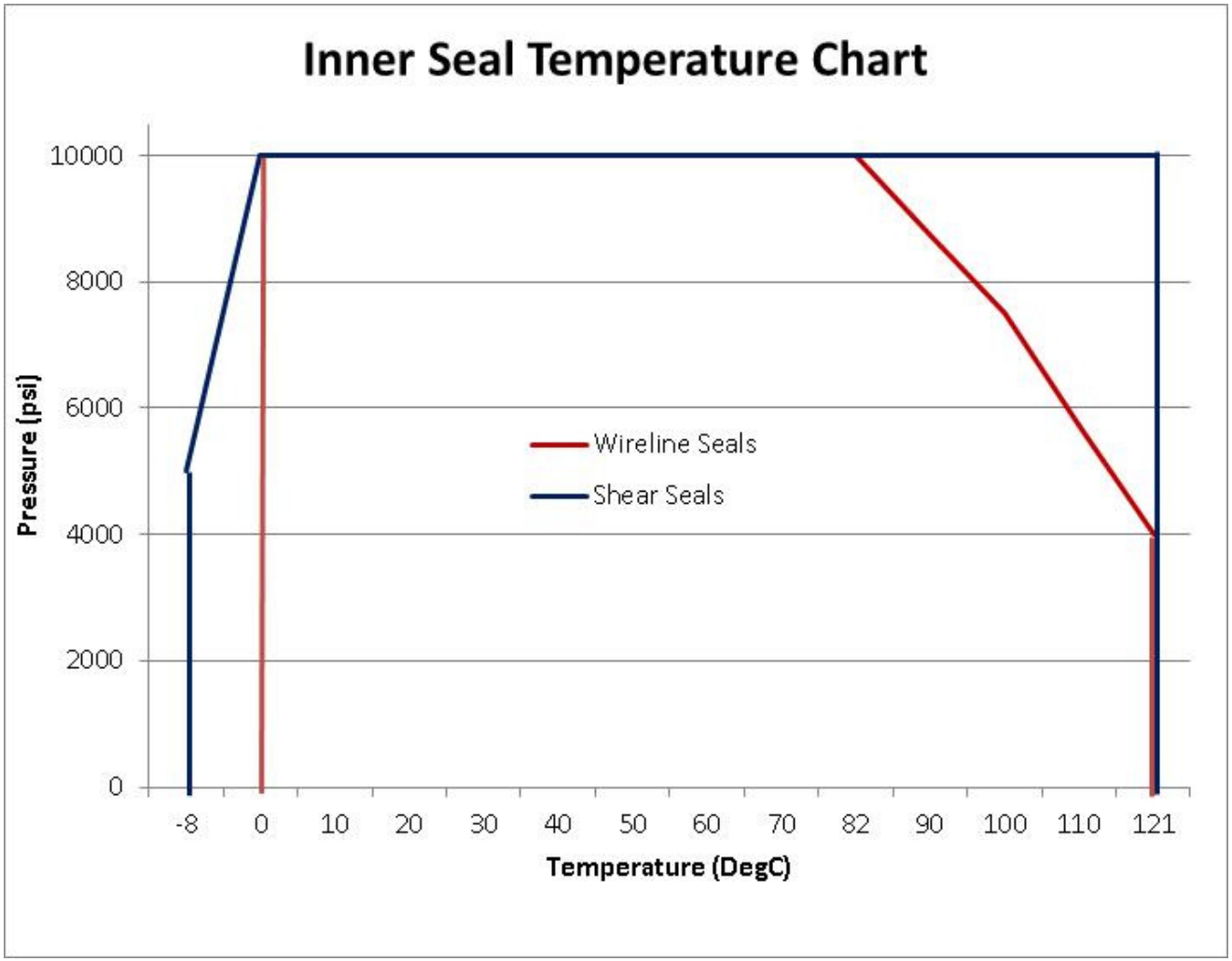


Figure 4: Qualified Operating Envelope, Inner Seals, (Tested Blind)

3 Technical Description

3.1 Basic Description

The Phuel BOP provides a positive barrier against well pressure while performing intervention operations. The equipment consists of three sets of hydraulically operated rams that can be individually pumped closed to form a seal against pressure. The orientation of the ram outer seal determines whether the rams hold pressure from above or below. By opposing adjacent ram sets it is possible to apply pressure between the rams through a grease injection port, normally at a pressure greater than the well pressure, and thus form a positive protection barrier. This technique is particularly effective when sealing against braided wire-line as a leak tight seal cannot be obtained due to the construction of the wire. The high viscosity of the grease allows the pressure to be maintained even though a small leak (of grease) still exists.

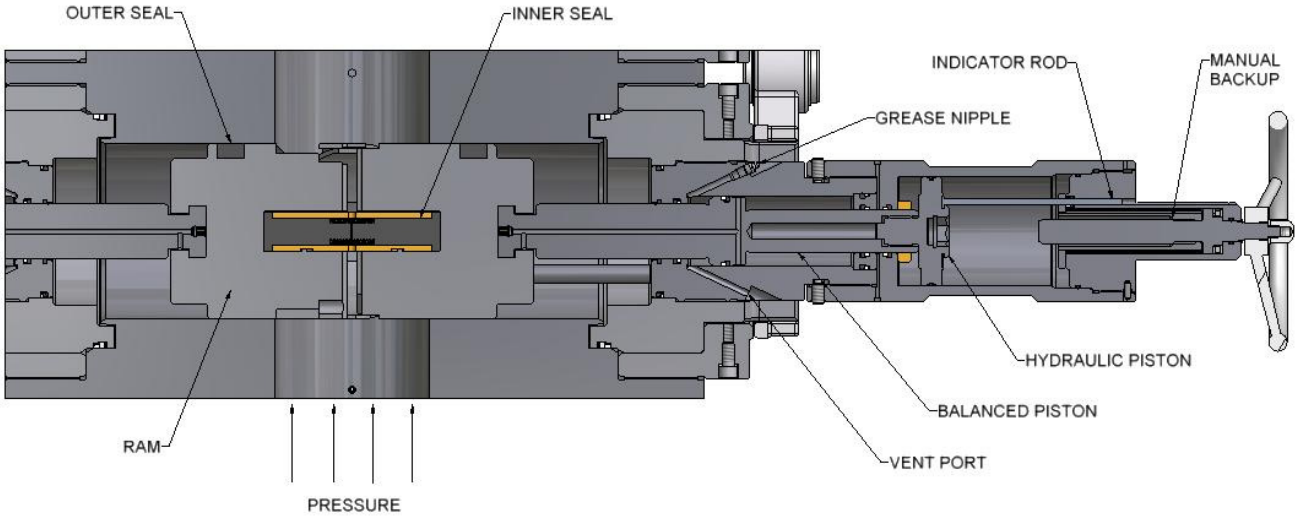


Figure 5: Section through BOP rams (closed position)

The rams are driven by a balanced hydraulic actuator, which consists of a piston with an indicator rod to provide visual confirmation when the rams are fully open. The actuator is designed with a balanced hydraulic piston that eliminates the end load that can be created due to well pressure. This means that the torque or closing pressure of the actuator is independent of the well pressure inside the BOP. This feature has two major advantages:

- The BOP can be closed with the same amount of effort no matter what the well bore pressure exists in the bore. This is particularly useful should the manual override of the actuator be required to be used and ensures quick and safe closure.

- The hydraulic volume requirements of the actuator are much less than a conventional BOP, this reduces the requirements for accumulator storage and charging.

A manual locking mechanism is also provided to ensure that when the BOP is closed hydraulically during operations it cannot be opened again until the mechanism is deliberately withdrawn. The manual locking mechanism can also be used to close the rams in the event that hydraulic pressure has been lost. Each of the actuators assemblies are identical on this Phuel BOP and so can be positioned in any ram bore. This provides excellent flexibility for maintenance and redress of the equipment.

4 Basic Operation

4.1 Operating the Rams

Note – Always ensure that the pressure across the rams has been equalised before opening.

4.1.1 Hydraulic Operation

The BOP has been provided with flexible armoured piping to offer the required fire protection level. Two connections are required for each ram set for open and close. It is important that both connections are connected, as the fluid displaced by the movement of the piston must be allowed to pass through the valve system back to the reservoir.

A Well Control Unit (WCU) is normally used to operate the BOP in an offshore environment. Refer to the relevant manual for that equipment for details of operation and connection. An alternative pump pack may be used for onshore maintenance work but the operation of this equipment is out with the scope of this manual.

4.1.2 Manual Operation

The rams can be closed manually (but not opened again) by turning the hand wheel in a clockwise direction some 30-40 turns providing that the hydraulic fluid from the other side (open port) is allowed to escape. The hydraulic connections must still, therefore, be made up to the WCU even when intending to operate the rams manually.

Once the rams have been closed using the manual method it is not possible to open them again without hydraulic pressure. The Hand wheel, however, must still be turned in an anti-clockwise direction until it stops to allow the piston to move fully back.

4.1.3 Locking the Rams

After closing with hydraulic pressure the piston can be mechanically locked by winding in the manual mechanism. Turning the hand wheel in a clockwise direction will advance the locking mechanism by 3mm per turn. It is therefore necessary to turn the hand wheel 30-40 turns to lock in the piston. Continue to turn until the hand wheel stops, indicating that the piston is now against the back-up lock.

For safety reasons and to reduce the mechanical effort required, **Phuel recommends that the hydraulic pressure be removed or reduced while closing the mechanical back up**. This reduces the risk of injury caused by the failure of a seal under hydraulic pressure and decreases the time required to implement the back up feature.

It is important to remember that the manual lock must be fully withdrawn before the rams can be opened. No damage to the mechanism will occur if pressure is reversed with the lock in place – providing that the maximum operating pressure is not exceeded.

4.1.4 Proper Use

In the event that the BOP is closed against wire during an operation, it is essential that the Inner seals are replaced after that job has been completed. Working practice and procedures must reflect this requirement.

Blind shear seals should always be fitted on the shear rams. They should be tested regularly to verify that they are suitable for operation. If they are ever closed during a live well operation they should be replaced when the operation is complete.

4.1.5 Bleed Down Rate in Gas Wells

To avoid explosive decompression in gas wells (or oil wells were there is a large quantity of gas present) it is important to control the bleed down rate of the pressure. The following procedure is recommended:

1. Reduce pressure from 10000 to 2000 Psi at a rate of 1000 psi per minute
2. Reduce pressure from 2000 psi to 1000 psi at a rate of 100 psi every one minute.
3. Reduce pressure from 1000 Psi to zero at a rate of 20 psi per minute.

4.2 Equalising across the rams

Each ram has a dedicated equalising valve block and these blocks are connected together to allow single point chemical injection, pressure measurement and dump facility.

There are four valves on each block, two are for equalising and two are for isolation. By opening and closing the appropriate valves it is possible to either equalize the pressure across closed rams, inject chemicals above or below any of the rams or a combination of both. There are two isolated external ports that allow the connection of a pressure gauge and drain hose if required.

Understanding The Layout

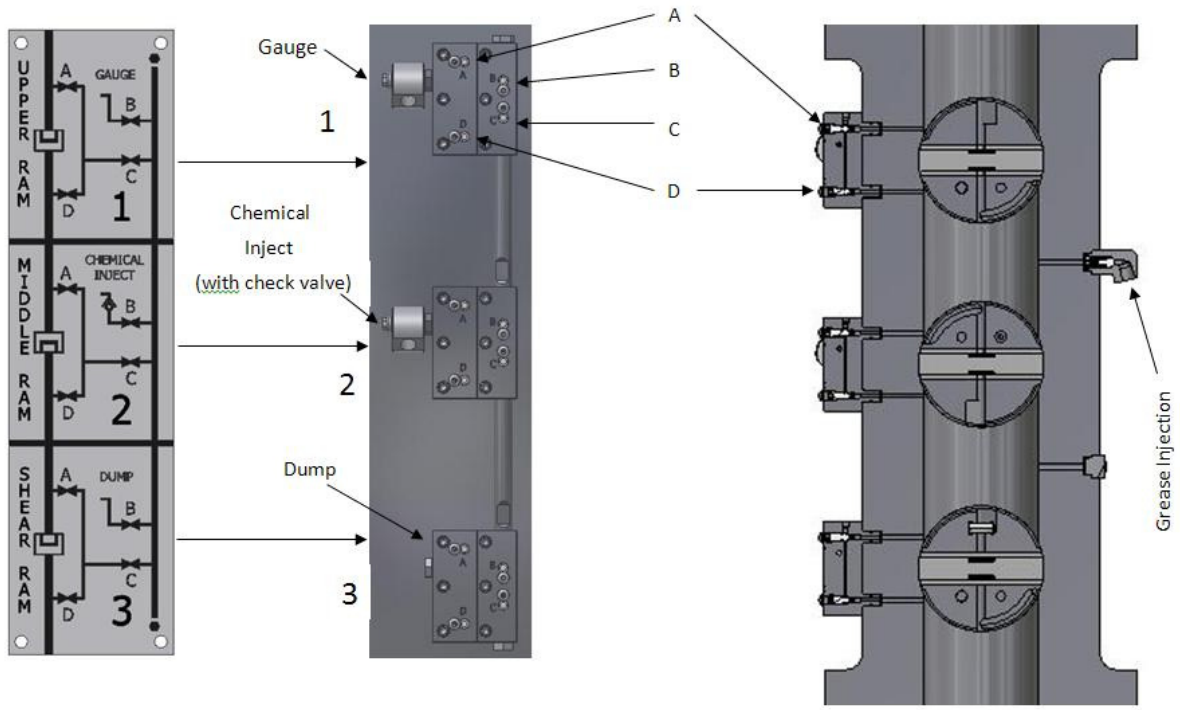
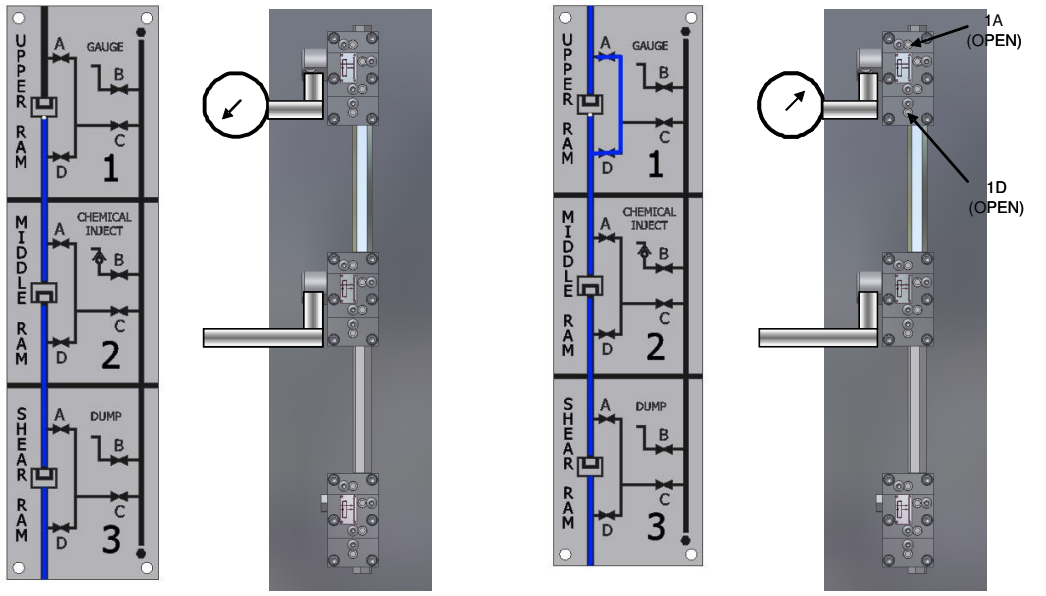


Figure 6: Equalisation Layout

Equalizing Across The Rams

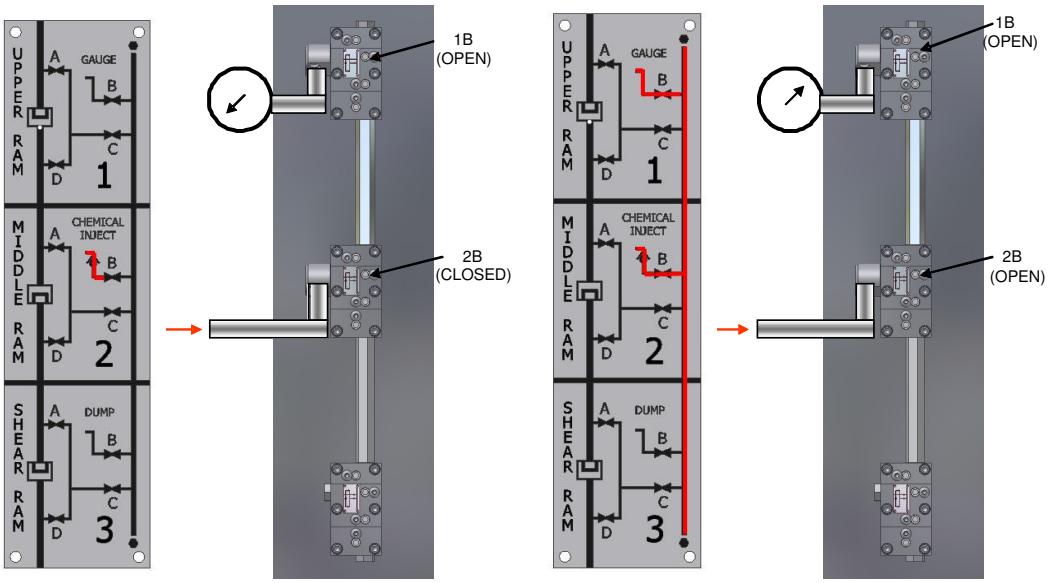


Pressure Below Upper Rams

Pressure Across Rams Equalised

ALL VALVES CLOSED UNLESS STATED OTHERWISE

Start Chemical Injection



Pressure reaches Isolation Valve

Pressure reaches chemical line &

ALL VALVES CLOSED UNLESS STATED OTHERWISE

Figure 7: Equalisation Operation 1

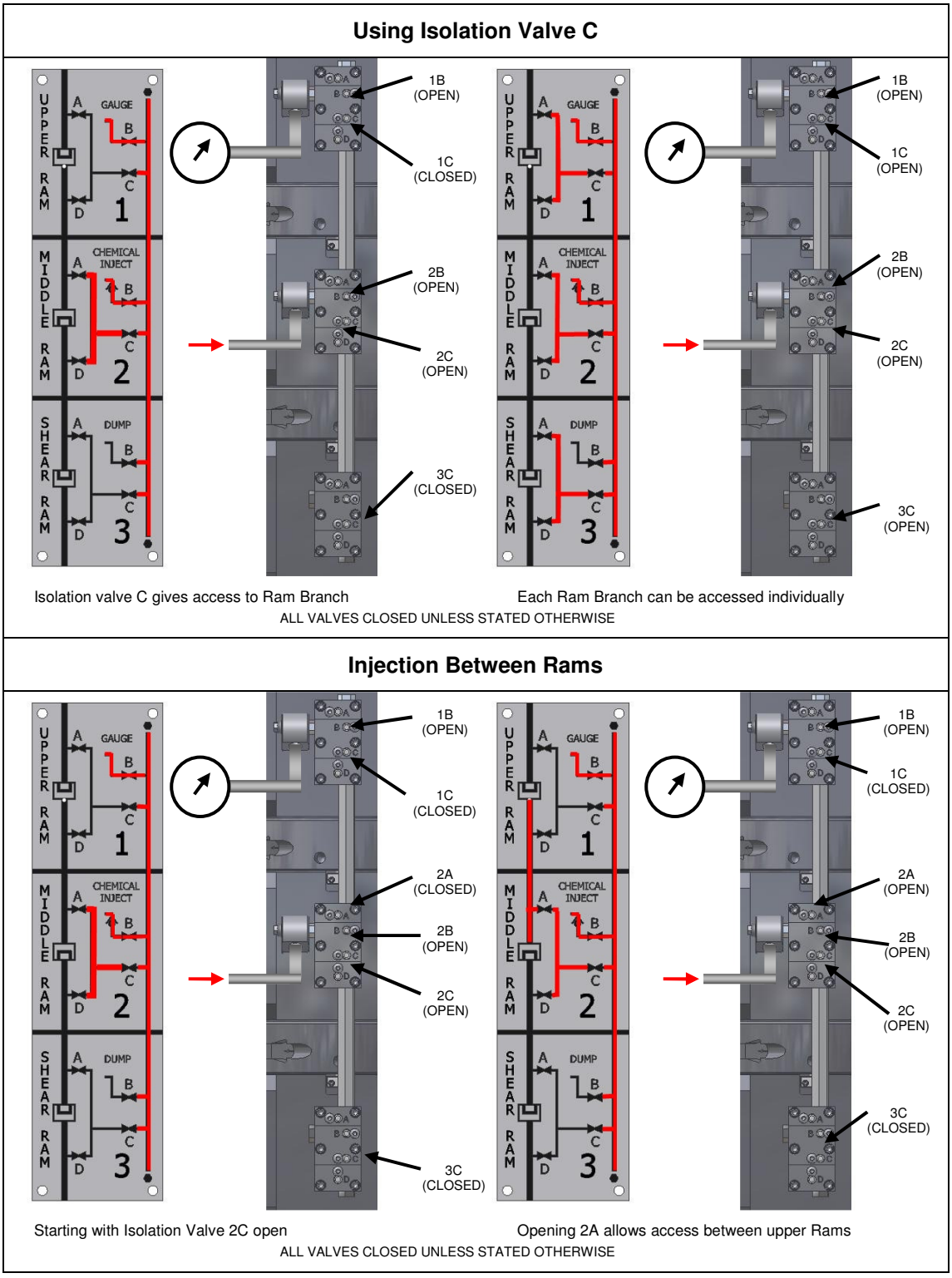


Figure 8: Equalisation Operation 2

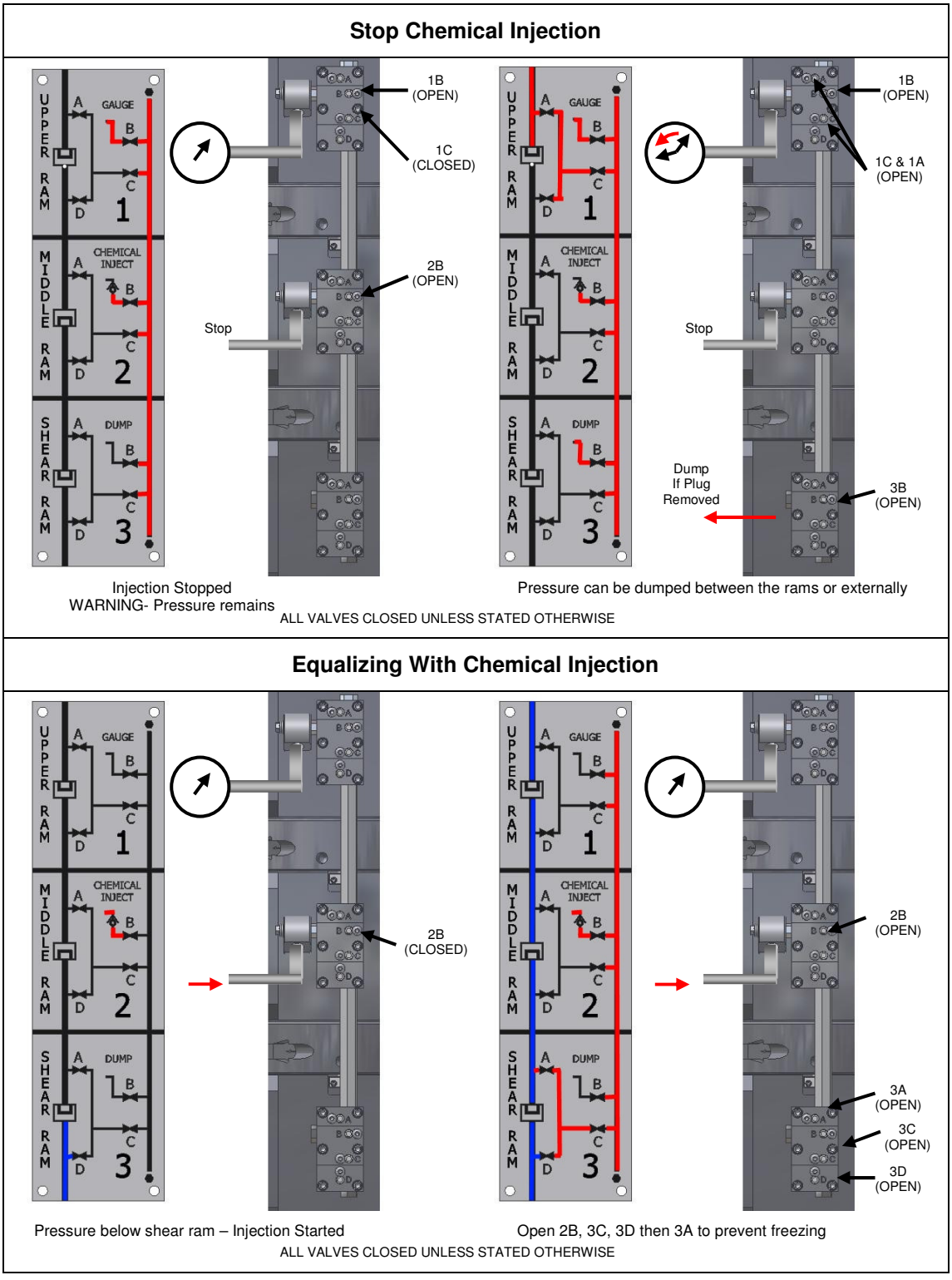


Figure 9: Equalisation Operation 3

4.3 Job Planning

4.3.1 Before the Job

- Check that the certification is within date and that the scheduled maintenance is up to date.
- All blind (shear) inner seals need to be inspected, and should be replaced where necessary. Wire-line seals must be tested without the use of test rods and must always be replaced after being closed on wire during normal operations. Always inspect the wireline seals for signs of wear or damage and replace if necessary.
- Examine the BOP Assembly, to make sure that it is good operating order and assembled with the Rams in the correct orientation for the desired operation.
- Functioning of the Rams may be checked, by running both Rams to the closed position. Do not exceed the maximum operating pressure when closing the Rams. Pressure test the rams from the direction of the well (or applied) pressure that is expected during the operation. This also verifies that the rams are in the correct orientation.

4.3.2 During the Job

- Special care should be taken that the Rams are fully open when passing any equipment through them. The impact of the tool string hitting a Ram may damage the Ram to such an extent that the Ram may no longer Seal, or prevents it from fully opening.
- Only lift the BOP using suitable lift caps. Do not sling or attach lifting equipment to the crash frame to lift the BOP assembly.
- Care should be taken to completely remove any residual pressure or accumulated pressure existing on Lubricator equipment above the BOP, before disconnecting the Lubricator.
- Hydraulic Hose ends should never be allowed to drop in to dirt or grit, or otherwise become contaminated with foreign matter. If end connections become dirty, they should be cleaned thoroughly with solvent and dried.
- Only clean Hydraulic fluid should be used (Shell Tellus 22 is recommended) to operate the BOP. The use of mixed types, dirty, or very old fluid of unknown origin is not recommended. When one of these conditions is known or suspected, the hydraulic system should be flushed and the hydraulic fluid replaced.

4.3.3 After the Job

After each job, the BOP should be thoroughly cleaned, repaired as may be required and redressed.

The BOP should be protected against the effects of corrosion to ensure that the expected functionality is achieved. The diagram overleaf highlights the key areas to consider.

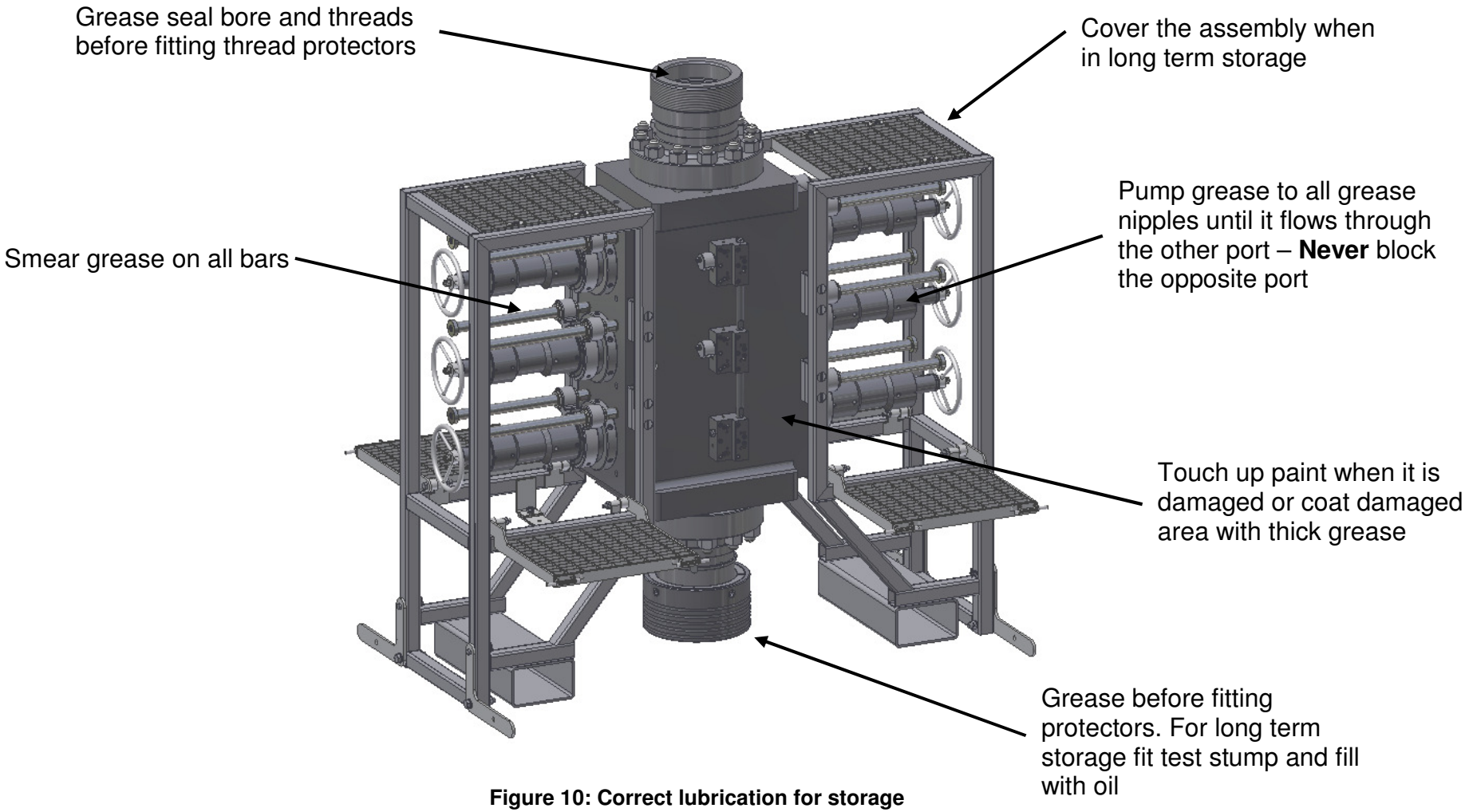

Grease seal bore and threads before fitting thread protectors
Cover the assembly when in long term storage
Pump grease to all grease nipples until it flows through the other port – **Never** block the opposite port
Smear grease on all bars
Touch up paint when it is damaged or coat damaged area with thick grease
Grease before fitting protectors. For long term storage fit test stump and fill with oil

Figure 10: Correct lubrication for storage

5 Operational Characteristics

5.1 Sealing Characteristics

5.1.1 Minimum Hydraulic Pressure

Testing has confirmed that the BOP requires 500 psi hydraulic pressure to close the BOP which is independent of well bore pressure due to the balanced piston.

5.1.2 Opening the BOP with differential pressure

It is not recommended that the BOP should be opened with differential pressure across the rams. The pressure should always be equalised first, using the equalising valves.

With differential pressure across the rams it is not possible for the well pressure to force the BOP open if the hydraulic closing pressure is removed. For well pressures up to 1,000 psi it is possible to open the BOP using the hydraulic pressure supply. This is not the case when the differential pressure across the rams is greater than 1,000 psi. The manual locking feature should therefore be used when the BOP is closed to prevent accidental opening

5.2 Fatigue Testing

Testing has been performed to establish the fatigue limit of the actuators and shear rams so that preventative maintenance can be scheduled to replace worn seals or parts.

A total of 546 close/open cycles have been completed without failure including 78 pressure cycles to maximum working pressure. This test simulates closing and opening the BOP once per day and testing well bore pressure at 300 psi and 10,000 psi once per week for 78 weeks of service. Records must be maintained to ensure that the seals are replaced before this limit is exceeded. If records do not exist then the seals should be changed every year as a minimum.

Fatigue life has not been defined on the wireline seals due to their less critical function and the fact that these are to be replaced whenever they are closed on the wire. Pre-job inspection to verify their condition is therefore required and replacement if they are not in good physical condition.

5.3 Ram Access Testing

Testing has been performed to determine the ability of the BOP to undergo repeated ram changes without affecting operating characteristics. The tests have shown that the rams were accessed a total of 200 times (test limit) without failure of the sealing or locking mechanism. Records must be maintained to ensure that the seals are replaced before this limit is exceeded. If records do not exist then the seals should be changed every year as a minimum.

5.4 Shearing Performance and limitations

Testing has been conducted to verify the shearing and sealing capabilities of the shear rams. The table below shows the results of these tests. The minimum tool string weight must be achieved either by direct weight or the combination of that and additional tension to ensure that the cutting performance is achieved. Due to the balanced piston, hydraulic pressure required to shear is irrespective of wellbore pressure.

Wire Size (dia)	No of wires	Wire Type	Tool string Weight during test	Hydraulic Pressure needed to shear	Maximum Wellbore Pressure (psi)
0.125"	1	Slick line	250 Kg	520 psi	10,000 psi
0.125"	6	Slick line	250 Kg	1040 psi	10,000 psi
0.160"	1	Slick line	250 Kg	520 psi	10,000 psi
7/32"	1	Braided	250 Kg	650 psi	10,000 psi
7/32"	2	Braided	250 Kg	1690 psi	10,000 psi
9/32"	1	Braided	250 Kg	975 psi	10,000 psi
5/16"	1	Braided	250 Kg	910 psi	10,000 psi
7/16"	1	Braided	250Kg	1820 psi	10,000 psi
15/32"	1	Braided	250Kg	1950 psi	10,000 psi

Table 2: Shearing performance and limitations

Note – **The shear blades are designed to cut only once. The blades must always be replaced once they are used to cut wire.**

5.5 Performance of Ram Guides

Testing has been conducted to verify that the wireline rams can centralise the cable without cutting – at extreme wire positions and with applied side loadings. The rams always closed without incident or damage to the cable. Operational planning and set up should still attempt to minimise the expected side loading on the wire by ensuring the lubricators are vertical and that the tool string is centralized as much as possible in the well bore.

5.6 Temperature and Pressure Limitations

Testing has been conducted to verify the performance of the BOP at extreme operating temperatures.

5.6.1 General Sealing

The BOP seals (typically of 90 hard Viton or 85 hard HNBR material with part numbers listed in this manual) have been qualified for operating temperatures between 0C and 121C with no restrictions to the operating pressure of 10,000 psi.

5.6.2 Blind Ram Shear Seals

The shear rams (using blind ram shear seals part number 190-4835-H80) have been qualified for operation between 0C and 121C with no restrictions to the working pressure of 10,000 psi, and up to 5,000 psi at -8C. See Figure 4

5.6.3 Wireline Multi-Seals

The wireline multi-seal (part number 190-4756-H80) have been qualified for operation between 0C and 82C with no restrictions to the working pressure of 10,000 psi. 7,500 psi at 100C, and 4,000 at 121C. Testing was completed with the wireline seal blind, ie without wire or test rods. See Figure 4

6 Maintenance

All maintenance to be carried out by suitably qualified and competent personnel

6.1 Introduction

Regular maintenance of the equipment using Phuel redress kits or approved spares is essential to its continued safe operation. Ensure that the pre and post job operating procedures are followed and that maintenance records are kept.

For fastener torques, refer to DOC-3821

6.2 Schedule

The maintenance schedule may be governed by international or company standards and the following is considered to be the minimum requirements.

6.2.1 Pre & Post Job

Refer to Section 4.3.1 and Section 4.3.3 for details.

6.2.2 Yearly

- Disassemble BOP
- Clean and degrease all components.
- Remove rust using a non toxic rust remover gel or liquid.
- Inspect the condition of sealing surfaces and surface coatings, repair/replace as necessary.
- Re-coat threads and sealing surfaces if necessary. Contact Phuel if in doubt. Apply protective coating to non painted surfaces
- Replace all elastomeric seals.
- Re-assemble BOP.
- Pressure Test to 300 psi and to maximum working pressure.
- Inspect paintwork and repair where necessary.

6.2.3 Five Yearly

- Recertification by Phuel Oil Tools in accordance with DNV-RP-E101

7 Maintenance

7.1 Safety

- This product contains high pressures, when in operation. Failure of any part may cause injury. Welding, corrosion, rough handling, or other abuse may affect the Integrity of this product.
- Many of the components are heavy and should not be lifted without lifting aids.
- Wear appropriate personal protective equipment.
- Do not over exert yourself while using torque wrenches. Use appropriate mechanical advantages when available.
- Ensure that all tools and equipment are in good condition and are suitable for intended use.

7.2 Ram Seal Redress

7.2.1 Access Rams

This procedure results in the removal of the actuator assembly from the BOP body in order to gain access to the rams.

- Ensure Rams are fully opened.
- Back off the Actuator from the BOP using a hex Key in the Cap Screw heads on the Locking Sleeve. Do not loosen the cap screws during this process.
- Once the thread is fully disengaged, pull the Actuator fully back to the End Stops. *(Note: Ram may be difficult to remove from the bore due to tight tolerances and grease suction. It may be necessary to connect up hydraulic pressure to the actuator and pump the ram out. Ram removal tool also available.)*

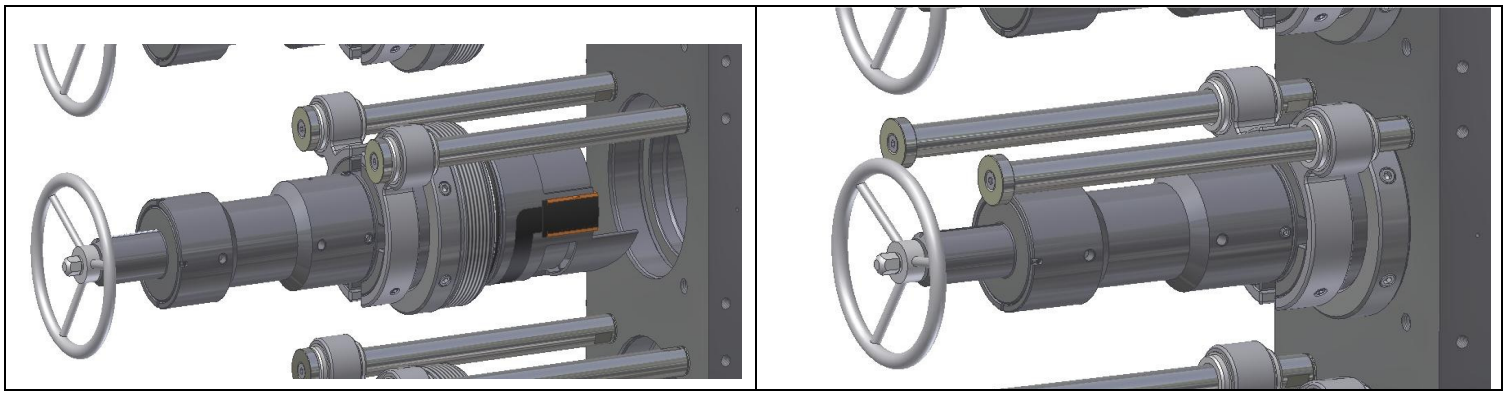


Figure 11: Accessing the rams

7.2.2 Ram Removal (not required to redress ram seals)

- Retract the actuator fully
- Pump the ram fully back to reveal the guide bar
- Undo the guide bar and slide out of the ram being careful not to loose the Nordlock washer
- Pump the ram forward about 2" until the back of the ram is clear of the actuator collar and seal housing (**NOTE: Beware that the ram does not rotate on the piston and fall off)**
- Remove Ram from Actuator, by sliding the Ram off the piston

7.2.3 Ram Seal Redress

- The Inner Ram Seals can be removed by simply sliding the seal out to either side
- The Outer Seal can be removed by levering out one end with a suitable instrument and simply pulling off.
- The Ram is now completely stripped down. Clean and inspect all parts for evidence of damage or excessive wear. Check the seals and replace if required. Repair or replace any damaged or worn parts. If the seals are to be redressed use the parts from the specified redress kit.
- Assemble Outer Seals by pushing the tab into the slot in the ram and working it around the radius of the ram. Tap home using a rubber or hide mallet and if required use a screwdriver to lever the second tab over the edge of the slot. Take care not to damage the Seal during assembly but expect that some slithers of rubber will be produced as the corners of the rubber seals are removed by the assembly operation. Tap all around the circumference of the seal to ensure that it is bedded into the groove and that the seal is not protruding above the ram diameter.
- Slide the Inner Seals into Ram taking care not to dislodge the outer seal in the process.

Figure 12: BOP Wireline Rams

Figure 13: BOP Shear Rams

7.2.4 Shear Blade replacement

- Remove socket head screw (note this is fitted with Loctite so may be tight to undo)
- Remove the brass pin (the end of the pin is threaded M3x0.5, if tight the pin can be removed with the use of an o-ring pick or a threaded bolt or screw)
- Slide the blade out and discard.
- Slide new blade in to the slot
- Slide in brass pin ensuring the tapped hole faces out
- Apply Loctite (243 recommended) to the set screw and fit with a maximum torque of 5 – 12 lb ft (7 – 15 Nm)

7.2.5 Re-attach to BOP Body

- If the rams were removed from the actuator (Section 7.2.2) then slide the ram back onto the piston taking careful note of the orientation of the rams depending on its intended use for the BOP assembly. (i.e. if pressure is to be held from below then the outer seal must be on top – otherwise it must be on the bottom). Attach a hydraulic pump to the open port of the actuator and pump the rams back into the recess in the actuator ensuring that the ram does not hang up on the actuator front face. When fully back remove the hydraulic pump.
- Place the Nordlock washer onto the guide bar, this can be held in place a small amount of grease to prevent it falling off during installation.
- Insert the guide bar with the Nordlock washer on the end into the guiding hole of the ram and through into the threaded hole of the actuator and tighten.
- Apply a generous coating of grease to the inner and outer seals.
- Push the ram back into BOP Body taking care that the edges of the guides pass into the seal bore and make-up the thread using a hex key in the cap head screws to provide the torque. Making up the thread will drive the actuator assembly fully home.
- The Ram Assembly is now fully made up. Repeat this procedure for each ram seal that need to be replaced.

7.3 Special Tools

General workshop tools will be required to maintain, and assemble and disassemble the BOP.

The tamperproof screws require a special tool to undo them:
950-4951-STL - Tamperproof Hex Key

To undo and tighten the balanced piston from the hydraulic piston, two hex keys are required, 3/8” and 1-1/8”. Phuel can supply a Hex bar to fit this piston and allow a 1-1/8” socket to be connected (950-4656-316).

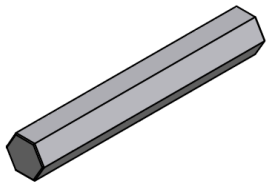


Figure 14: 950-4656-316 - Piston Assembly Tool

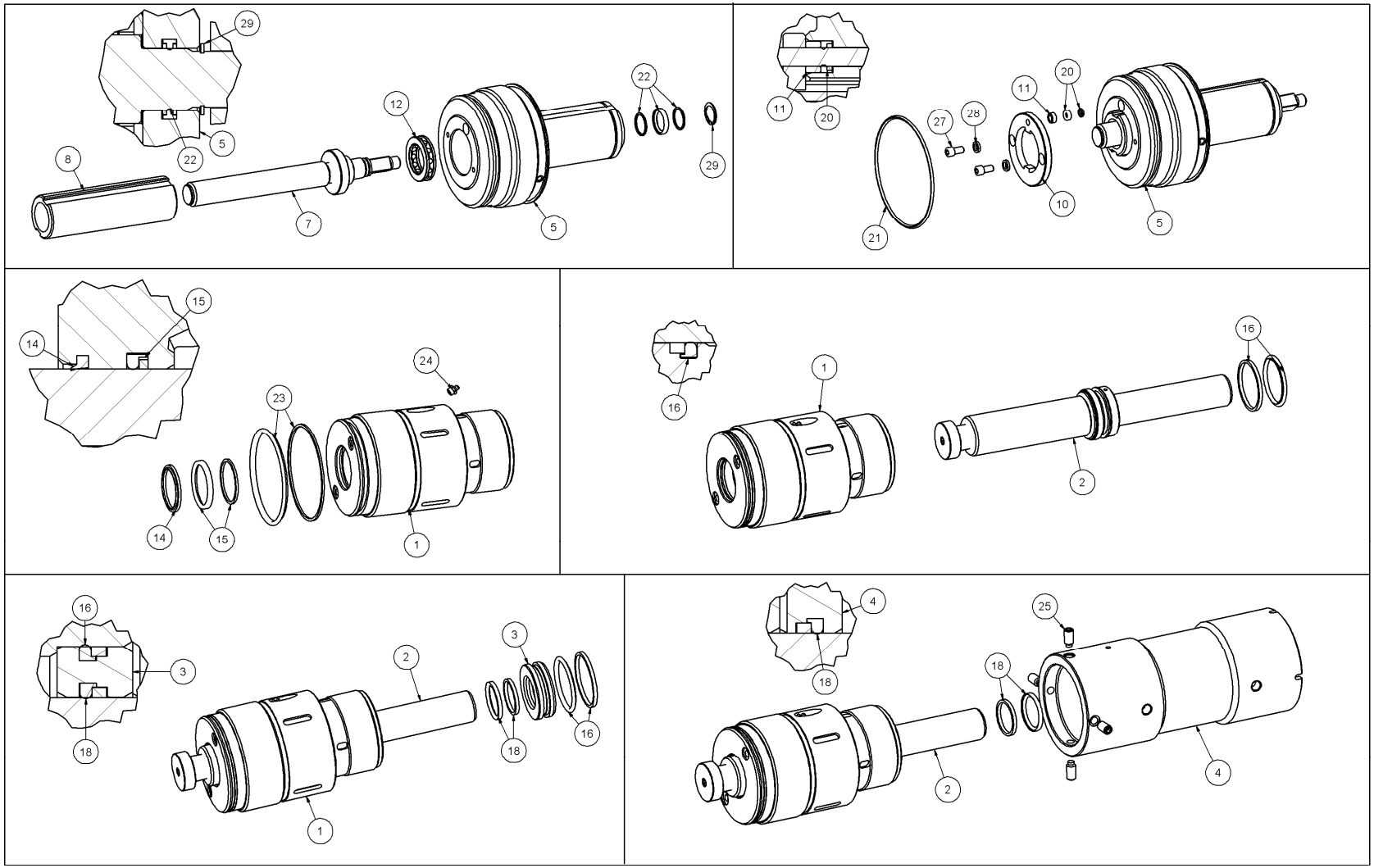


Figure 15: Actuator Module (Part 1) – *Item Nos refer to Parts List 190-4711-HV0*

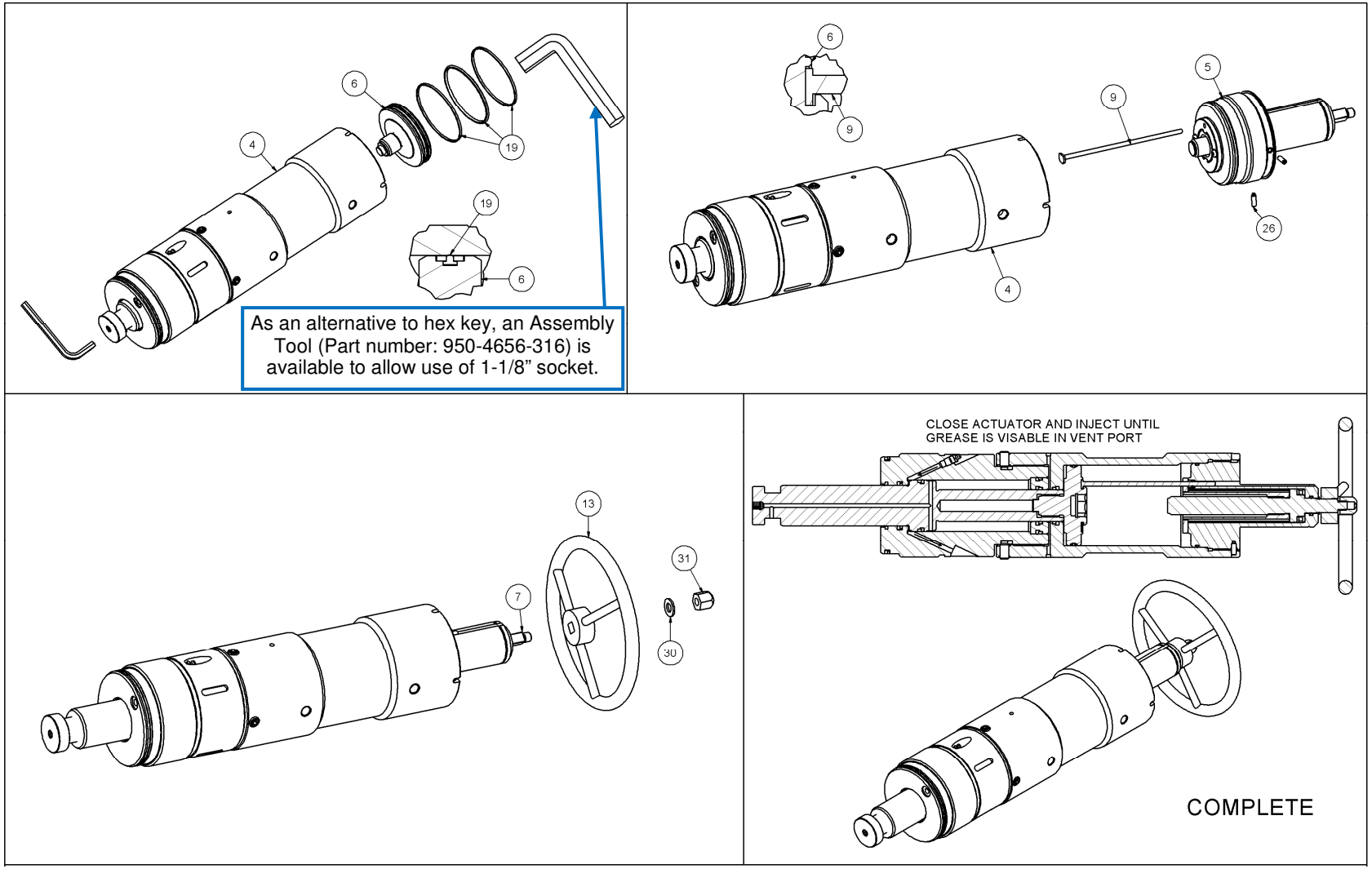


Figure 16: Actuator Module (Part 2) – Item Nos refer to Parts List 190-4711-HV0

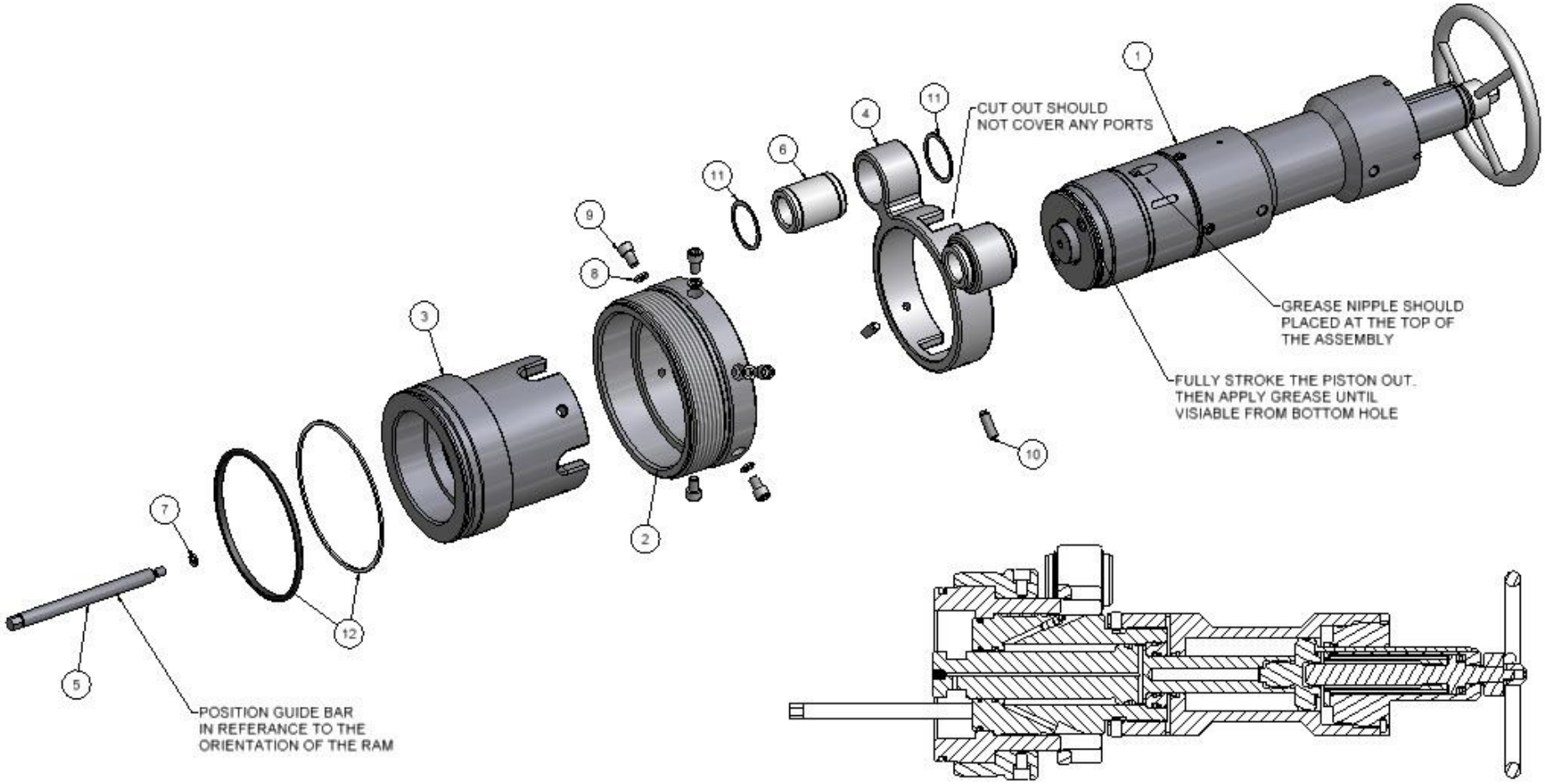


Figure 17: Final Actuator – *Item Nos refer to Parts List 190-4727-HV0*

7.4 Maintenance Record Sheet

Date Performed	Type of Maintenance	Performed By	Verified By	Comments

Example

Table 3:Maintenance Record

8 Testing

All testing is to be carried out in the designated test area and by suitably qualified and competent personnel. Safety procedures must be followed.

WARNING: Trapped air requires considerable time to compress and when it is compressed is highly dangerous. It has enough stored energy to separate parts with considerable force.

Rams should not be tested with test rods.

8.1 Prepare BOP for pressure testing

- Check the pressure rating for all test equipment is sufficient to allow testing to be carried out.
- Check / replace o-ring on the pin part of the BOP.
- Ensure BOP is placed in an area suitable for pressure testing.
- Fit the BOP to the test stump.
- Makeup BOP (collar) on test stump by turning the "collar" all the way down, and then back off maximum 1/2 turn
- Fill BOP with test fluid.
- Connect the hydraulic hoses from the BCU to BOP to operate the rams.
- Check all connections / hoses that they are secured with safety wire before use
- Vent BOP Rams by hydraulic operation of the Rams.
- On completion of venting the Rams fit test cap, ensuring the valve is in the open position to allow air to vent and top up the BOP with Test Fluid. Once all air is expelled close valve.
- The BOP is now prepared for testing

8.2 Body Test

- Ensure that all the rams are in the open position
- Close equalizing valve 1A, all other equalizing valves to be open.
- Disconnect pipe on the grease injection and the chemical injection connector plate to test check valves.
- Fit the pressure test hose to the test stump.
- Pump slowly up to 300 psi and observe for leaks. Hold Time 5 min
- Bleed the pressure to zero
- Pressurize to MWP of BOP and observe for leaks. Hold Time 15 min
- Bleed of pressure to zero and drain BOP.

8.3 Ram test: Shear seal

Rams should not be tested with test rods.

- With BOP Rams in the open position and fill up the bop with the test medium by using the test pump. Ensure valve on test cap remains open for the duration of this test.
- Close Shear Ram, this is done by activating the BCU Shear seal valve to "close" position, then pressurize up to a maximum of 3,000 psi on the ram – Test fluid will be observed coming out of the Test Cap valve.
- Close equalizing valves. (Note - equalizing valve setup to be added to the test chart with number and position)
- Connect pressure test pump to the Test Stump so that pressure testing is done from the underside of rams and up
- Observe Test Cap valve during testing for fluid leaking out under pressure.
- Put up safety barrier in the work area.
- Pressurize up to 300 psi low pressure test - observe if there are leaks. Hold Time 5 min
- Bleed the pressure to zero
- Press up to the MWP for the bop in accordance documentation – maintain the pressure for 15 min without leakage.
- Bleed the pressure to zero.
- Open rams on bop by enabling BCU Shear seal valve to "open" position.

8.4 Wireline Ram Seal Test (Between the ram)

Rams should not be tested with test rods.

- Ensure upper Test Cap is not fitted (or is open)
- Ensure all Rams are in open position
- Open the equalizer valve between the respective rams to be tested.
- Connect the test hose in the 1A on equalizing block (gauge port)
- Close the Middle Ram.
- Open connector on the test stump for verification of leakage on the lower ram.
- Fill the BOP with test fluid to above the Upper Ram. Close the Upper Ram by setting Ram to 3,000 psi by activating the valves on the BCU to "close position.
- Pump test medium thru the equalizing. Block 1A to see fluid is rising above the upper ram.
- **Open equalizing valve : 1A, 2B, 2D – Close all other valves**
- Put up safety barrier in the work area.
- Pressure up to 300 psi for 5 minutes and observe for leaks
- Bleed off to zero
- Pressurize to MWP according to documentation – maintain the pressure for 15 min without leakage. Bleed pressure to zero.

- Open the rams- open lower first, and then the upper ram.

8.5 Post Test Procedure

- Disconnect All Hoses
- Remove Test Cap
- Drain out test fluid and circulate with water displacing fluid or lubricating oil
- Remove BOP from Test Stump
- Grease end connections and fit oiled thread protectors

9 Parts List and Drawings

Item	Part Number	Description	Qty
1	193-4717-480	BOP BODY (7-3/8) V2	1
2	190-4727-HV0	7-3/8" BALANCED ACTUATOR	6
3	190-4752-HH0	SHEAR RAM ASSEMBLY - 7-3/8" V3	1
4	190-4755-HH0	WIRELINE RAM ASSEMBLY 7-3/8" V3	2
5	193-4758-STL	7-3/8" TRIPLE CRASHFRAME V2	1
6	190-4768-HV0	EQUALISATION BLOCK ASSEMBLY V4	3
7	190-4109-X90	SLIDER ROD (40mm X 22")	12
8	190-4261-316	END STOP V3	12
9	SHC-0663-HTS	Soc Hd Cap 3/4 Length 1.25in	16
10	CSU-0585-3A4	CSink Soc Hd Size 1/2 Length 1 in	12
11	WNL-0660-316	Nordlock Washer size 3/4	16
12	125-3368-AL7	STUD 1.500-8 UN X 8.500 LONG	24
13	128-2280-A2H	HEAVY DUTY NUT 1.500-8 UN	24
14	900-2218-STL	SEAL RING BX 156	2
15	193-4812-HV0	INJECTION MODULE 7-3/8 BOP	1
16	950-4030-STL	HEX KEY 5/16, T-HANDLE	1
17	193-5156-SS0	7-3/8" TRIPLE BOP HYD KIT	1
18	WNL-5183-316	NORDLOCK WASHER M24	12

Note item 19 and 20 are separate assemblies,
Item 19 – Top Sub - 125-3216-HV0.
Item 20 – Bottom Sub - 125-3215-HV0

Table 4: 193-4653-HV0 Parts List

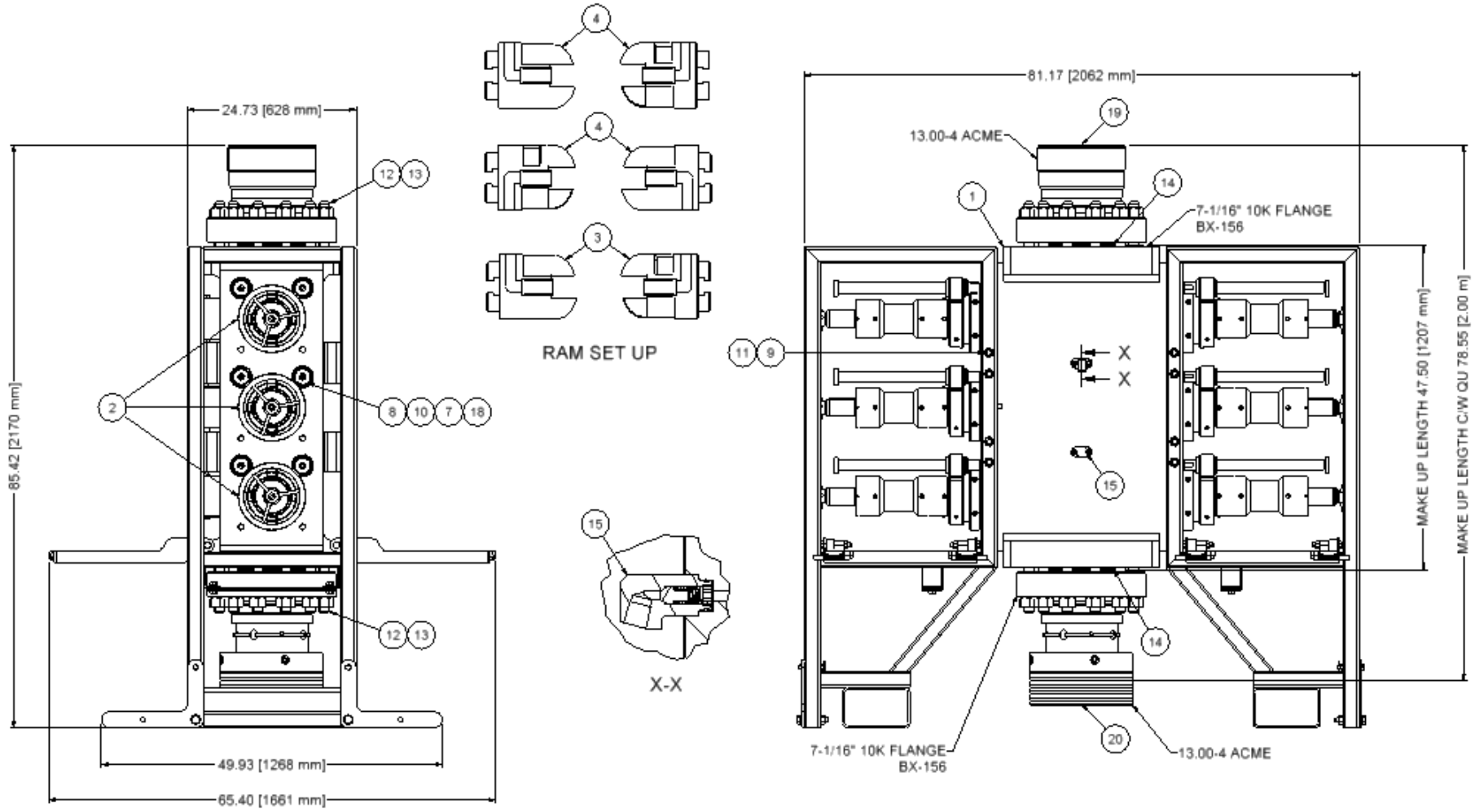


Figure 18: BOP (Part 1)

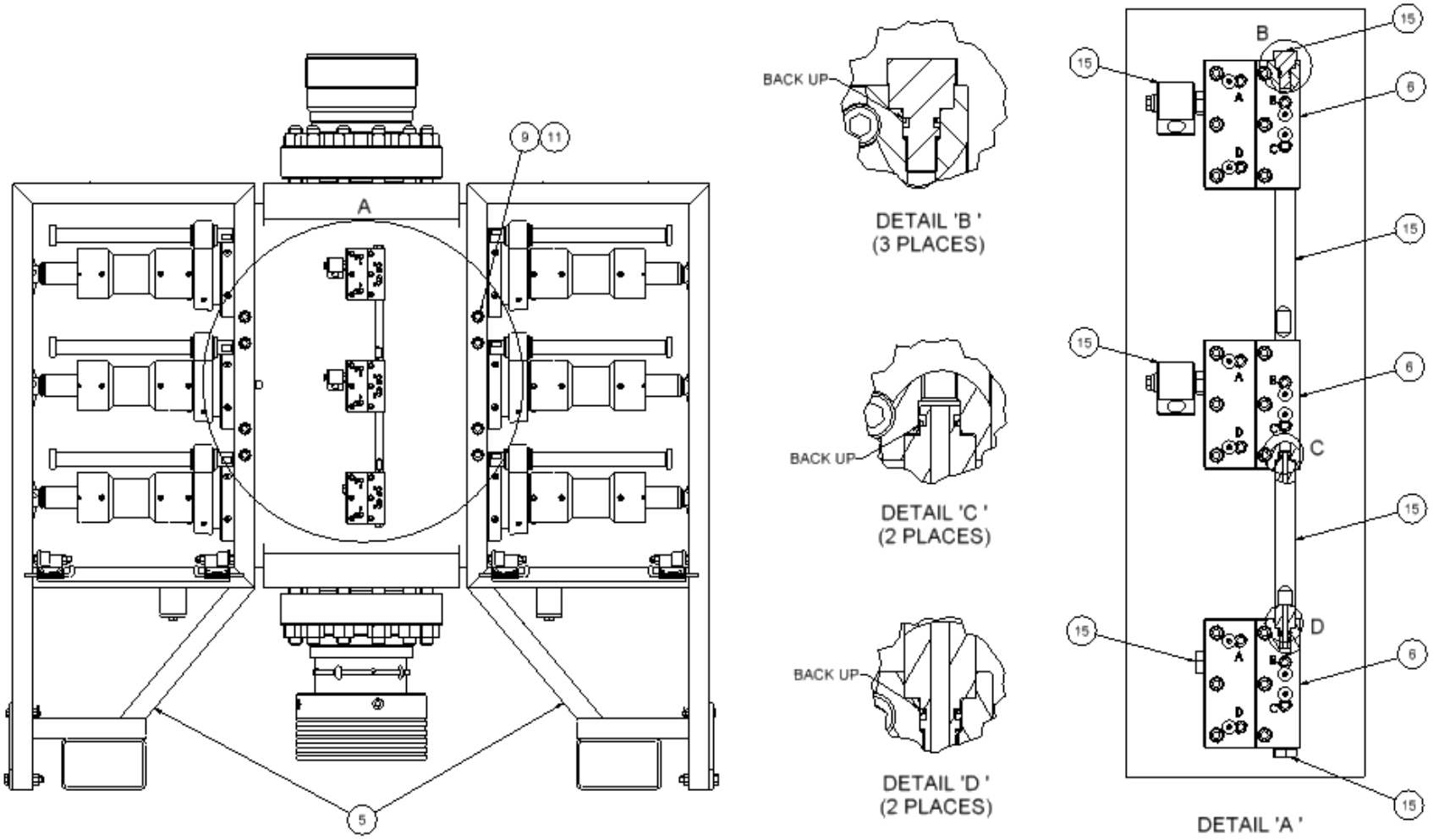


Figure 19: BOP (Part 2)

Item	Part Number	Description	Qty
1	190-4711-HV0	BALANCED ACTUATOR 10k	1
2	190-3041-480	LOCKING SLEEVE (7-3/8)	1
3	190-4714-480	7-3/8" BALANCED ACT SEAL HOUSING	1
4	190-4712-ALU	7-3/8" BALANCED ACT BRACKET	1
5	190-4729-480	7-3/8" RAM GUIDE BAR	1
6	950-5080-STL	LINEAR BEARING (TK-40-UU NB TOPBALL)	2
7	WNL-4767-316	M11 / 7/16" NORDLOCK WASHER	1
8	WNL-0580-316	WASHER NORDLOCK (M12)	6
9	SHC-0583-316	Soc Hd Cap 1/2 UNC Length 3/4 in	6
10	SDU-0587-316	SET SCREW DOG POINT 1/2" X 1.500" LONG	2
11	190-4245-STL	SPIRAL SHAFT RING DCR-62 (62mm SHAFT)	4
12	802-4728-H85	PISTON P-SEAL 8.255	1

Table 5: 7-3/8” Balanced Actuator Assembly 190-4727-HV0

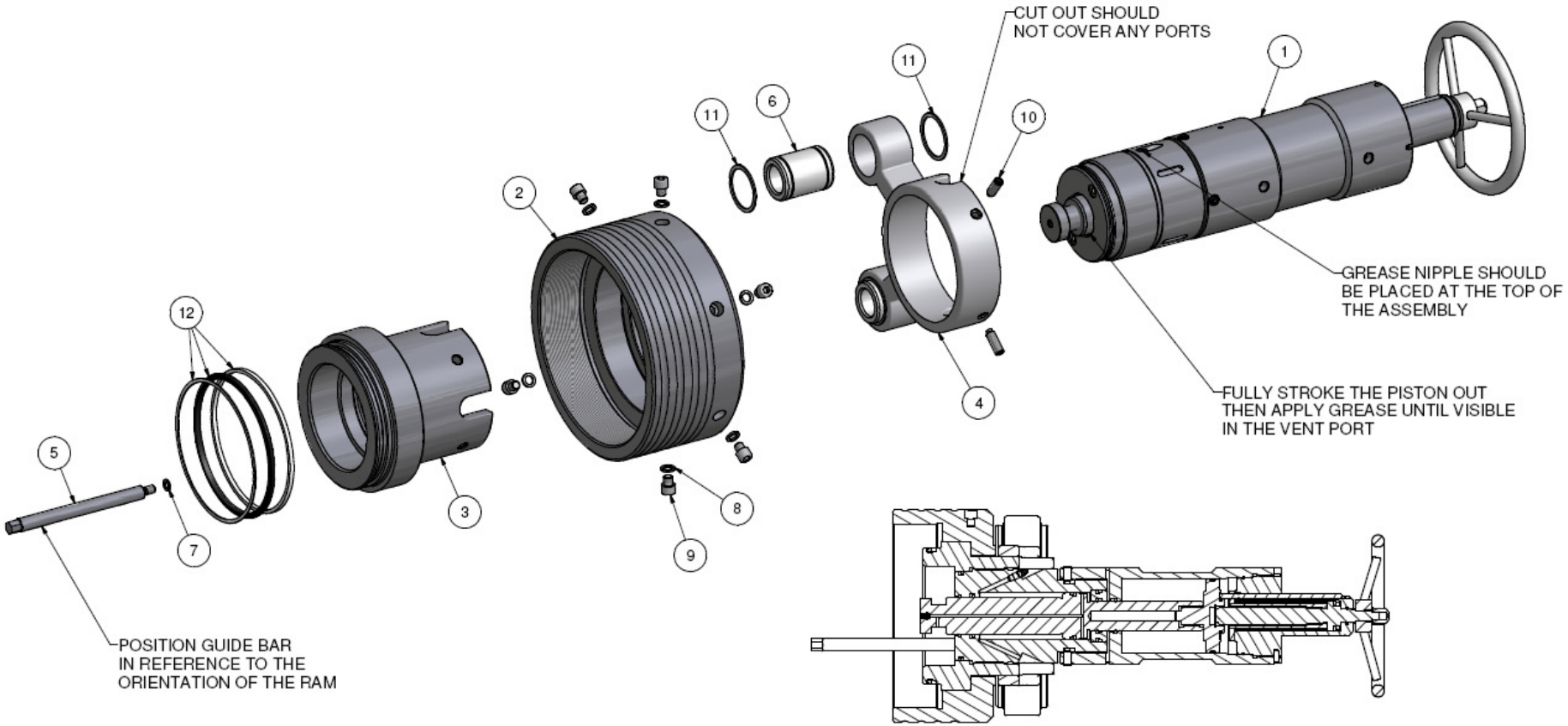


Figure 20: 7-3/8” Balanced Actuator 190-4727-HV0

Item	Part Number	Description	Qty
1	190-4706-480	BALANCED HOUSING	1
2	190-4702-480	BALANCED PISTON	1
3	190-4707-480	SEAL RING	1
4	190-4960-480	Balanced Act Hydraulic Cylinder (5.19 stroke) 3.5	1
5	190-4934-480	ROTATE END CAP (5.19 STROKE)	1
6	190-4959-480	Balanced Act Hydraulic Piston (5.19 stroke) 3.5	1
7	190-4709-480	DRIVE ROD	1
8	190-4705-480	DRIVE SLEEVE	1
9	190-4704-316	INDICATOR ROD	1
10	190-4283-460	3" MOD KEY PLATE	1
11	190-4319-PEK	3" MOD KEY BUSH	1
12	190-4338-STL	Thrust Bearing (FAG 811 06)	1
13	190-4246-304	HAND WHEEL 250mm	1
14	190-4720-FPM	GREASE SCRAPER RING 2.25 BORE	1
15	802-4718-H85	ROD T SEAL 2.25"	1
16	802-4716-H85	PISTON T-SEAL 2.850	1
17	802-4724-H85	PISTON T SEAL 3.12"	1
18	802-4339-H85	ROD T-SEAL 1.750	2
19	802-4961-H85	T-seal 3.5 double wide backups	1
20	802-4342-H85	ROD T-SEAL 0.245	1
21	801-0246-V90	O-RING - B.S SIZE 246	1
22	802-2505-H85	ROD T-SEAL 0.825 DIA	1
23	802-4723-H85	PISTON P SEAL 5.42"	1
24	100-2179-STL	GREASE NIPPLE 1/8 NPT	1
25	SDU-0585-316	Set Screw Dog Point 1/2 UNC X 1.000 in	4
26	SDU-0505-HTS	Set Screw Dog Point Size 1/4 Length 0.75 in	3
27	SHC-0503-HTS	Soc Hd Cap Size 1/4 Length 0.5 in	2
28	WNL-0500-316	1/4" Nordlock Washer	2
29	190-2491-STL	EXTERNAL CIRCLIP (SH-75)- 0.750 DIA	1
30	WNL-4449-316	NORDLOCK WASHER (NL12 SP SS)	1
31	190-1704-STL	Acorn Nut 1/2-13	1

Table 6: 10K Balanced Actuator Assembly 190-4711-HV0

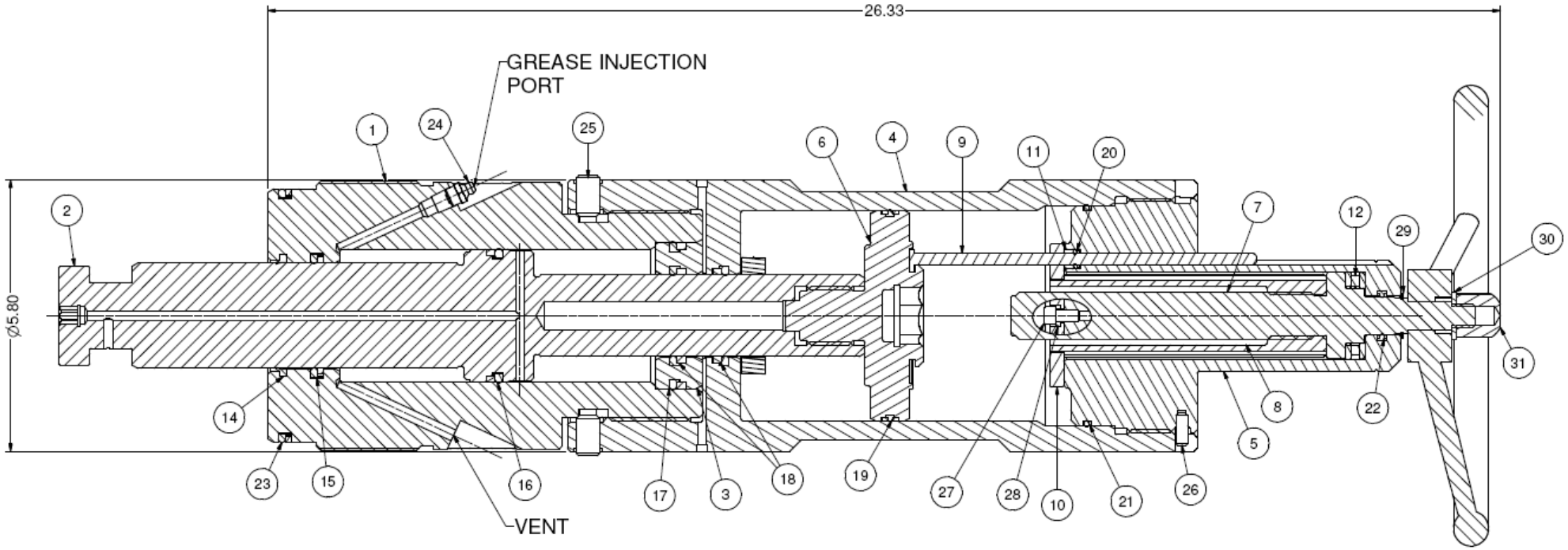


Figure 21: 10K Balanced Actuator Assembly 190-4711-HV0

Item	Part Number	Description	Qty
1	190-4769-480	EQUALISATION BLOCK V4	1
2	110-2979-316	VALVE	4
3	190-2823-PEK	VALVE SEAT	4
4	100-2209-316	NPT SOCKET HEAD PLUG 1/8	2
5	801-0108-V90	O-Ring - B.S Size 108	4
6	801-0113-V90	O-Ring - B.S Size 113	2
7	SHC-0555-AL7	SOC HD SCREW 3/8 UNC X 3.0 LONG	3
8	SHC-0557-AL7	Soc Hd Cap Size 3/8 Length 3.5 in	3
9	STC-0542-316	3/8" X 1/2" TAMPERPROOF BUTTON HEAD SOCKET CAP SCREW	4
10	WNL-0540-316	Nord Lock Washer Size 3/8	10

Table 7: Equalisation Assy 190-4768-HV0

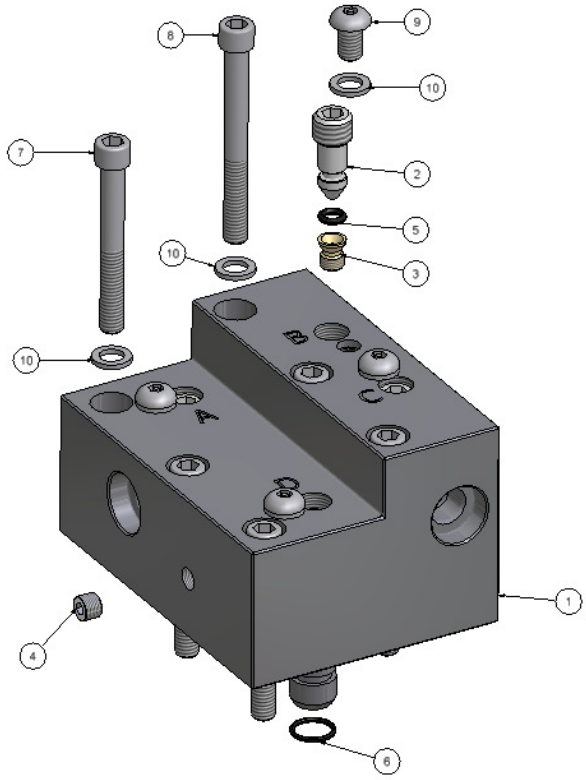
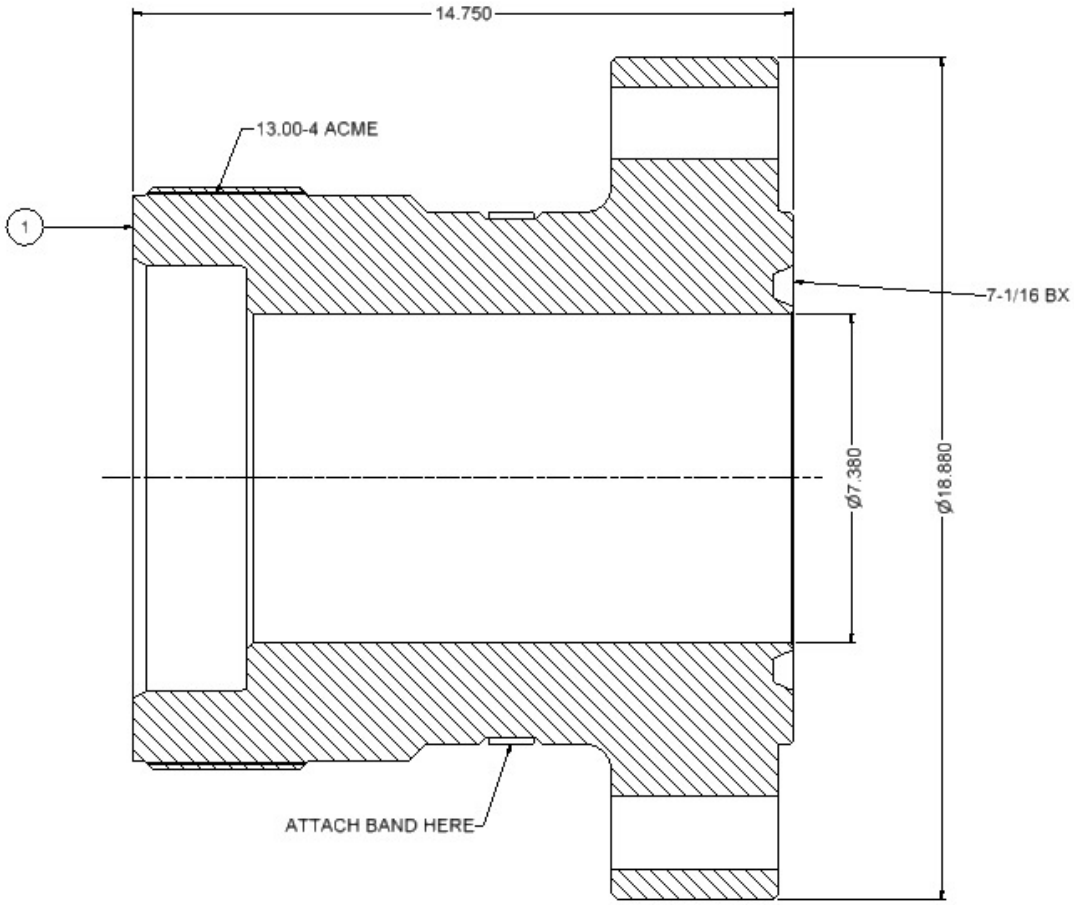


Figure 22: Equalisation Assy 190-4768-HV0

Item	Part Number	Description	Qty
1	125-3054-480	FLANGE ADAPTER (7-1/16 BX X 13-4 BOX)	1
100	910-4454-N66	13.00"-4 FEMALE PROTECTOR (FOR BOX)	1

Table 8: Top Sub Assy Parts List 125-3216-HS0



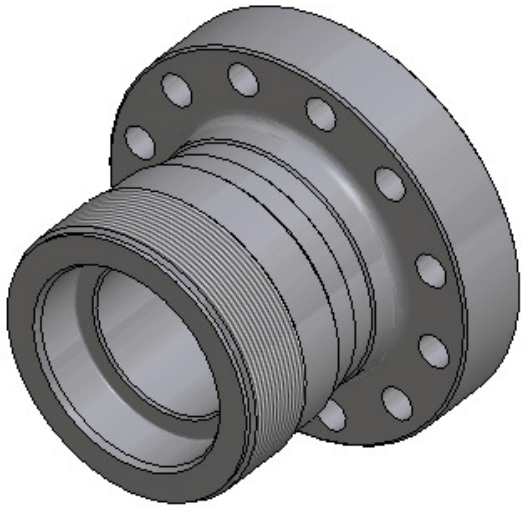


Figure 23: Top Sub Assy 125-3216-HV0

Item	Part Number	Description	Qty
1	125-3053-480	FLANGE BODY (7-1/16 BX X 13-4 PIN)	1
2	110-2949-480	SPLIT COLLAR 13-4 (SPLIT TYPE)	1
3	110-2950-480	SPLIT RING 13-4	1
4	110-2951-3A4	STOP PIN (3/4 UNC)	4
5	WNL-0660-316	Nordlock Washer size 3/4	4
6	801-0447-V90	O-Ring - B.S Size 447	1
100	910-4453-N66	13.00"-4 MALE PROTECTOR (FOR P&C)	1

Table 9: Bottom Sub Parts List 125-3215-HV0

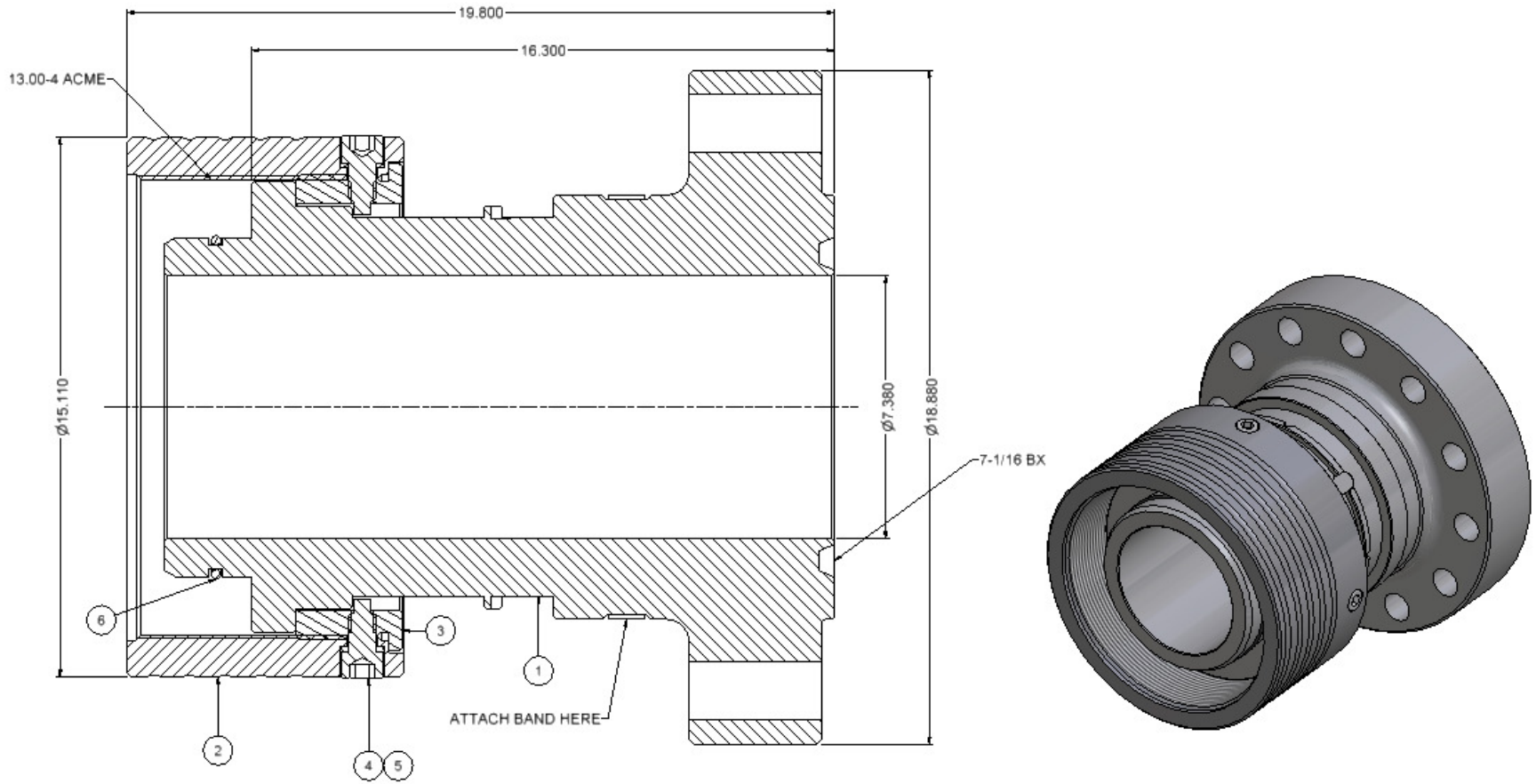


Figure 24: Bottom Sub Assy 125-3215-HV0

Item	Part Number	Description	Qty
1	190-4725-480	7-3/8" RAM LH V3	1
2	190-4726-480	7-3/8" RAM RH V3	1
3	190-3231-H70	OUTER SEAL - 8.00	2
4	190-4756-H80	WIRELINE RAM INNER SEAL - SIZE 8.00	2

Table 10: Wireline Ram Assy 190-4755-HH0

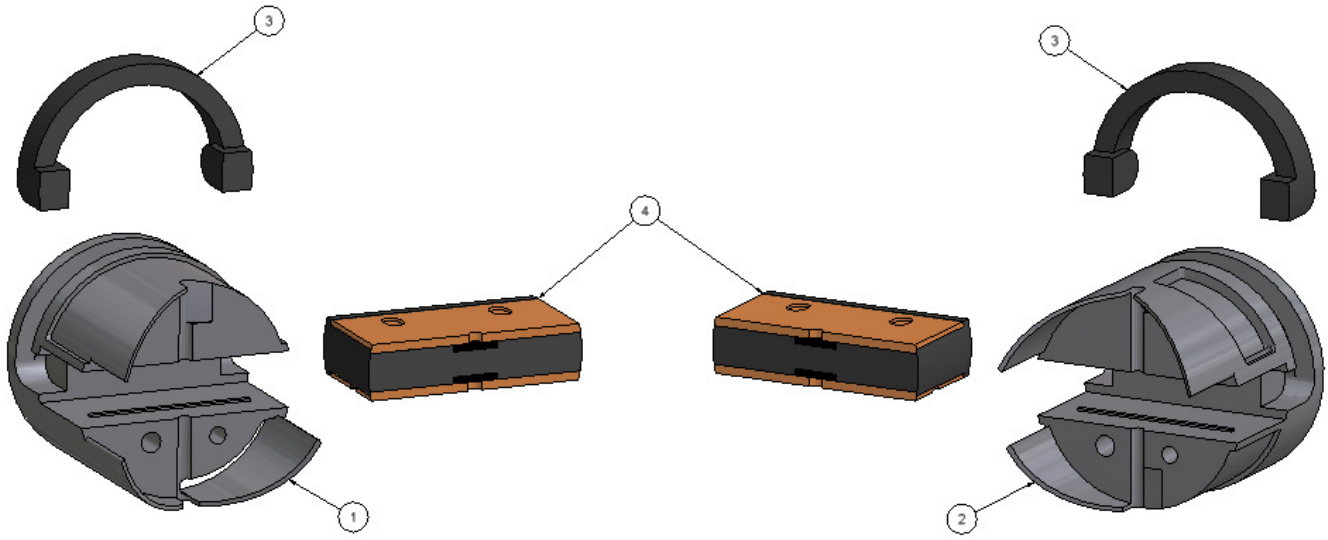
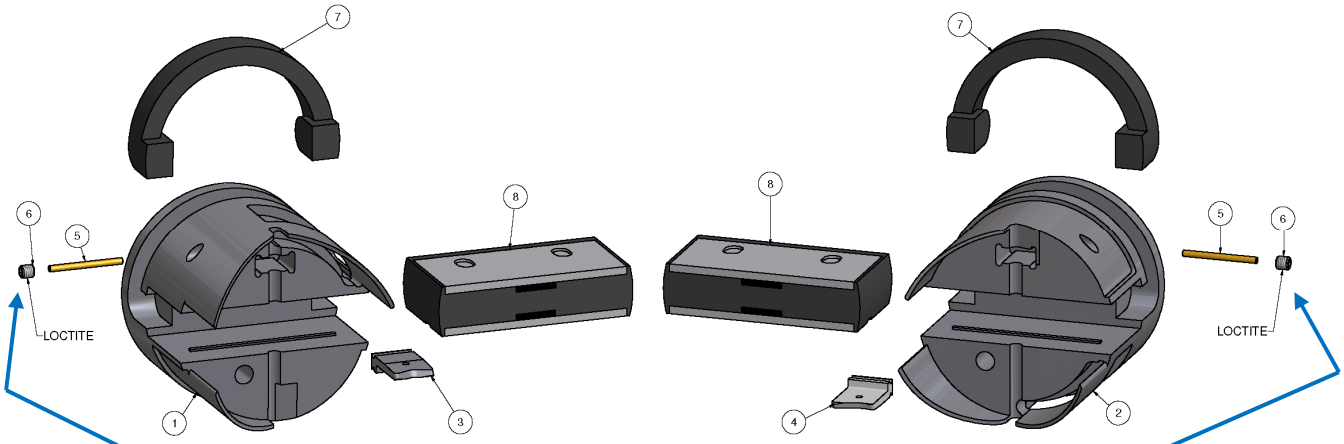


Figure 25: Wireline Ram Assy 190-4755-HH0

Item	Part Number	Description	Qty
1	190-4753-480	7-3/8" LH SHEAR RAM V3	1
2	190-4754-480	7-3/8" RH SHEAR RAM V3	1
3	190-5100-411*	SHEAR BLADE	1
4	190-5102-411*	SHEAR BLADE SINGLE GUIDE	1
5	190-3741-B21	SHEAR BLADE PIN	2
6	SCU-0581-304	1/2"-13 x 0.500" LONG SET SCREW CUP POINT UNC	2
7	190-3231-H70	OUTER SEAL - 8.00	2
8	190-4835-H80	BLIND RAM INNER SEAL - SIZE 8.00	2

* SHEAR BLADE – Was: 190-3740-411 – Now: 190-5100-411, and SHEAR BLADE SINGLE GUIDE – Was: 190-3815-411 – Now: 190-5102-411. Blades altered to improve the shearing capability for heavy duty cables such as 7/16 Dyform. The older shear blades are still fit for purpose but will be phased out

Table 11: Shear Ram Assy 190-4752-HH0



Care must be taken when fitting item 6 Pt No SCU-0581-304

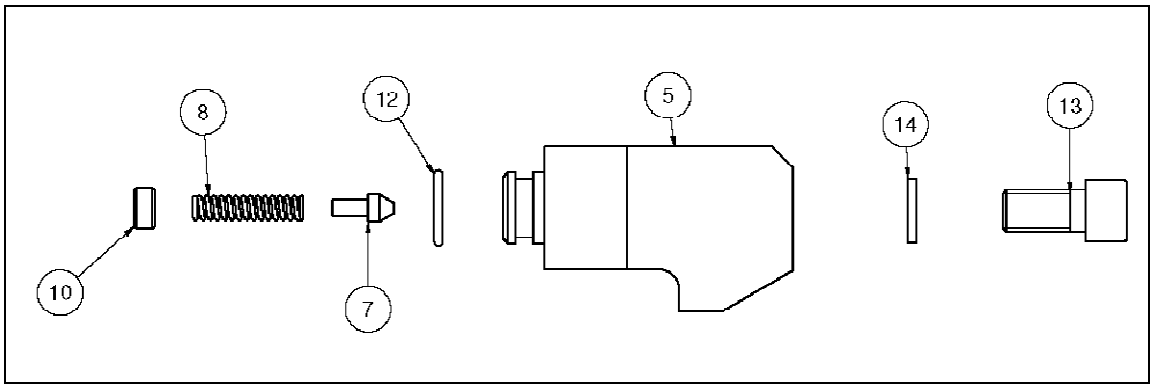
DO NOT OVERTIGHTEN TORQUE TO 5 – 12 lb ft (7 – 15 Nm)

(Loctite 243 recommended)

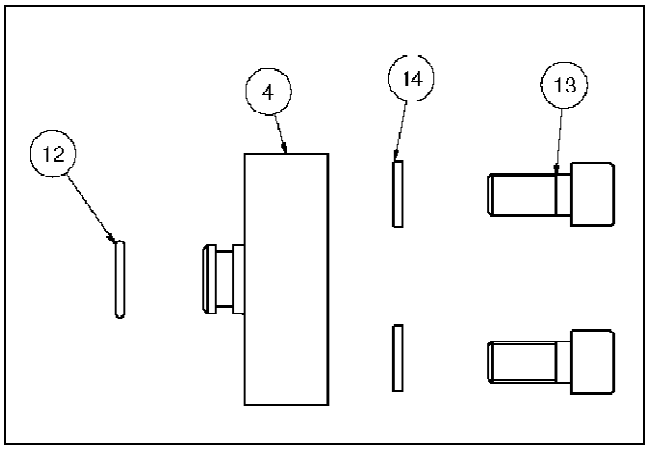
Figure 26: Shear Ram Assy 190-4752-HH0

Item	Part Number	Description	Qty
1	190-4820-HV0	10K SWIVEL ASSEMBLY V2	2
2	190-4808-480	15K PORT BLANK END V2	3
3	190-4809-480	15K EXTENSION BAR V2	2
4	205-2105-480	BLANK TEST PORT	1
5	900-3019-480	CHECK HOUSING	1
6	100-2114-PEK	CHECK VALVE SEAL	1
7	190-2786-PEK	CHECK CONE SEAL	1
8	190-1749-STL	COMP SPRING (C5515650)	1
9	145-2185-STL	COMP SPRING (D22120)	1
10	190-1703-STL	Hollow Lock Screw 3/4-16 (MAC-765)	1
11	802-4816-H85	PISTON P-SEAL (0.580)	7
12	801-0119-V90	O-Ring - B.S Size 119	2
13	SHC-0583-3A4	Soc Hd Cap 1/2 UNC Length 3/4 in	4
14	WNL-0580-316	WASHER NORDLOCK (M12)	4
15	193-4435-316	10K MODULAR BOP VALVE PLATE (TRIPLE)	1
16	910-2186-N66	1/2in SHIPPING CAP PLUG	1

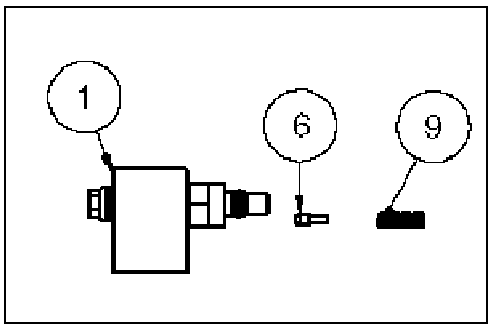
Table 12: Triple Injection Module Parts List 193-4812-HV0



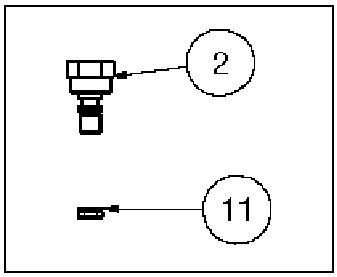
Check housing (Grease injection)



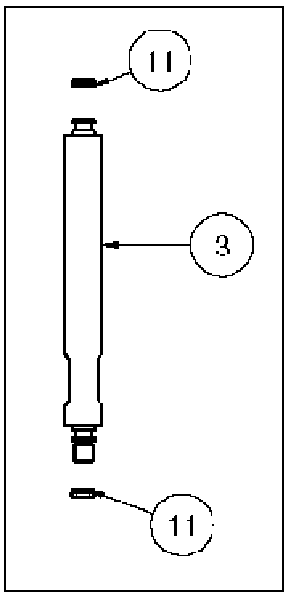
Blank Saversub



Chemical Injection Swivel



Equalising Block Blank



Equalising Block Extension

Figure 27: Triple Injection Module 193-4812-HV0

Item	Part Number	Description	Qty
1	190-4817-480	SWIVEL MANDREL V2	1
2	190-4264-480	SWIVEL OUTLET (1/2 NPT)	1
3	190-4265-PTF	PLAIN BEARING	2
4	801-0114-V90	O-Ring - B.S Size 114	2
5	802-4816-H85	PISTON P-SEAL (0.580)	1
6	HFU-0542-316	HEX FLANGED SCREW 3/8 UNC X 0.5" LONG	1
7	WNL-4266-316	NORDLOCK WASHER (NL3/8" SP SS)	1
10	910-2186-N66	1/2in SHIPPING CAP PLUG	1

Table 13: 10K SWIVEL ASSY 190-4820-HV0

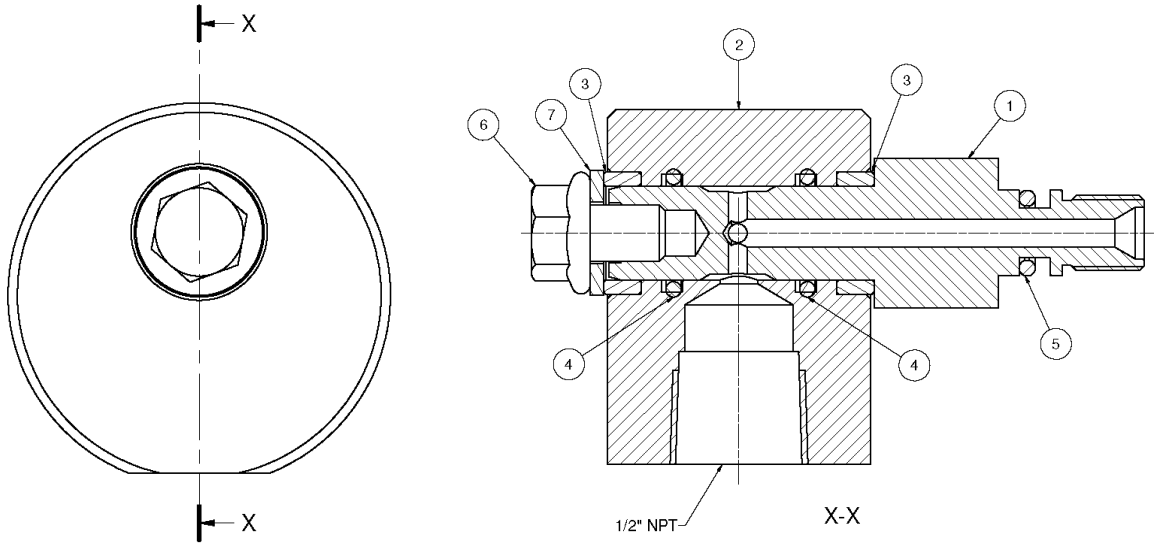


Figure 28: Right Angled Swivel Assy 190-4820-HV0

Item	Part Number	Description	Qty
1	900-3331-316	BULKHEAD CONNECTOR (6MBC6N)	6
2	950-3336-316	3/8 ALOK TEE (6ET6)	6
3	950-3335-316	3/8” BSPP M x 3/8” Tube CONNECTOR (6MSC6R)	12
4	900-333-316	3/8” TUBE – 0.036 WALL	2
5	950-3169-316	CONNECTOR ¼” BSPP X ¼” NPT (1252-04-04S)	12
8	190-2746-STL	QUICK RELEASE COUPLING (QR74QC5-06)	3
9	950-4434-316	NPT SOCKET HEAD PLUG ¼”	12
10	196-2918-316	BOP HOSE - OPEN	6
11	196-2919-316	BOP HOSE - CLOSE	6
12	950-5158-316	SnapTite 71 – 71N08NPT	1
13	950-5159-316	QR74-06 FEMALE (QR74AFBC-5-06SS)	1
14	950-5160-316	½” NPT MALE x MALE NIPPLE	1
15	950-3348-PLA	TUBE CLAMP (2 X 3/8) PLASTIC HALF	30
16	950-3348-3S0	TUBE CLAMP (2 X 3/8) COVER PLATE	15
17	950-3348-3S1	TUBE CLAMP (2 X 3/8) WELD PLATE	15
18	950-3348-3S2	TUBE CLAMP (2 X 3/8) M6X35mm BOLT	15
19	950-3898-316	½” NPT (m) X 3/8” NPT (m) CONNECTOR	1

Table 14: BOP Hydraulic Fittings Parts List 193-5156-HS0 (No dwg)

10 Spares

Use only spares supplied or approved by Phuel Oil Tools Ltd.

It is recommended that sufficient quantities of the following spares be maintained to ensure that the equipment is always available when required.

Elastomeric spares are supplied in Viton and HNBR material as standard. Other materials are available please specify when ordering.

Part Number	Quantity	Description	Comment
RDK-4727-HV0	8	ACTUATOR REDRESS KIT	
RDK-4812-HV0	1	INJECTION REDRESS KIT	
RDK-4768-HV0	4	EQUALISATION REDRESS KIT	
RDK-3215-HV0	1	BOTTOM SUB REDRESS KIT	

Table 15: BOP Full Elastomer Redress Kit RDK-4653-HV0 (No Ram Seals)

Part Number	Quantity	Description	Comment
RDK-4711-HV0	1	ACTUATOR REDRESS KIT	
802-4728-H85	1	P-SEAL (PISTON 8.255)	

Table 16: Actuator Redress Kit RDK-4727-HV0

Part Number	Quantity	Description	Comment
802-4718-H85	1	ROD T SEAL 2.25"	
802-4716-H85	1	PISTON T-SEAL 2.850"	
802-4724-H85	1	PISTON T SEAL 3.12"	
802-4339-H85	2	ROD T-SEAL 1.750"	
802-4961-H85	1	PISTON T-SEAL 3.5"	
802-4342-H85	1	ROD T-SEAL 0.245"	
801-0246-V90	1	O-RING - B.S SIZE 246	
802-2505-H85	1	ROD T-SEAL 0.825" DIA	
802-4723-H85	1	PISTON P SEAL 5.42"	

Table 17: Actuator Redress Kit RDK-4-HH0

Part Number	Quantity	Description	Comment
190-3231-H70	2	OUTER SEAL – 8.00''	
190-4756-H80	2	MULTI-LINE INNER SEAL – 8.00''	

Table 18: Wireline Ram Redress Kit RDK-4755-HH0

Part Number	Quantity	Description	Comment
190-3231-H70	2	OUTER SEAL – 8.00''	
190-4835-H80	2	BLIND INNER SEAL – 8.00"	

Table 19: Shear Ram Redress Kit RDK-4752-HH0

Part Number	Quantity	Description	Comment
801-0108-V90	4	O-RING – B.S SIZE 108	
801-0113-V90	2	O-RING – B.S SIZE 113	
190-2823-PEK	4	VALVE SEAT	

Table 20: Equalisation Redress Kit RDK-4768-HV0

Part Number	Quantity	Description	Comment
802-4816-H85	7	PISTON P-SEAL (0.580)	
801-0119-V90	2	O-RING - B.S SIZE 119	

Table 21: Injection Redress Kit RDK-4812-HV0

Part Number	Quantity	Description	Comment
801-0447-V90	1	O-RING – B.S SIZE 447	

Table 22: Bottom Sub Redress Kit RDK-3215-HV0

Individual seals and parts may be ordered as required. See the parts list in the previous section for part numbers

10.1 Supporting Equipment

950-4951-STL - Tamperproof Hex Key
950-4656-316 - Piston Assembly Tool